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Original Communications.

SOME STUDIES ON THE THERAPEUTICS OF ACUTE GONORRHŒA.

By Edward Martin, A.M., M.D.,
Clinical Professor of Genito-Urinary Surgery, University of Pennsylvania; Surgeon to Philadelphia, St. Agnes, and Howard Hospitals; Assistant Surgeon, University Hospital.

THOUGH the subject-matter of the present paper has to do with the treatment of gonorrhœa, it is well to preface with the statement that no new remedy has been employed in the series of cases which have been studied, no specific has been discovered, and the observations founded upon a somewhat extended clinical experience have value only in so far as they tend to corroborate or disprove the efficiency of remedies and of methods which are as old as is genito-urinary surgery.

It was in a spirit of therapeutic scepticism that two years ago I began an investigation as to the beneficial effect which could be attributed to the most popular antiblennorrhagic remedies. Practically, only those drugs which have received the seal of the highest professional endorsement were used in my series of clinical observations. In one or two instances, influenced by the gaudy results of enthusiasts as reliable from a scientific stand-point as it is possible for such men to be, I departed from

the safe, beaten track into by-ways, which, as usual, instead of proving short cuts to cure, led to confusion and disappointment.

Since, for the purpose of arriving at a practical estimate as to the efficacy of a remedial measure, it is necessary to begin the investigation with a knowledge as to the course of disease when not treated, the first step was necessarily the observation of cases of gonorrhœa to whom no drugs were administered. Previous experience had long since shown that urethritis which is utterly disregarded is even more violent, more prolonged, and more frequently complicated than that subject to the varied and often vicious treatment which urethritis receives at the hands of the druggist, the experienced friend, and, too often, the family doctor.

Whether or not the oft-reiterated statement that gonorrhœa treated only by careful attention to the health of the patient, regulation of his bowels, partial or complete rest, liquid or semi-liquid diet, the administration of alkaline diuretics, runs a course as favorable as when treated by balsams and injections, was a question which required settlement before experimenting with any of the so-called specific remedies.

In all, eight cases were treated in accordance with general therapeutic principles, omitting both balsams and injections. Six of these cases suffered from the active symptoms of posterior urethritis; in two chordee was unusually well marked and prolonged, and in six the running continued more than ten weeks, requiring sounds, instillations, and astringent injections before it ceased. This is too small a number to advance as a positive proof of the failure of what might be called the strict conservative treatment. From a business stand-point, however, it was quite convincing, and since then it has not seemed necessary to corroborate my conclusion as to the inferiority of this treatment to that of internal medication and local applications.

Granting, then, that the course of gonorrhœa is favorably modified by a special treatment, skilfully applied, the question as to the choice of drugs and methods next required investigation. Since salol and the balsams are generally given in combination, it is not possible to determine the exact value of each. For the purpose of throwing light on this point, each drug employed was given to a series of from twenty to forty cases, uncombined with other remedies.

The drugs chosen were salol, oleoresin of cubebs, balsam of copaiba, and oil of sandal-wood.

Without taking up the individual cases in detail, and without attempting to draw conclusions from a summarization of the length of treatment, since in this small number of cases such conclusions are sure to be misleading, I shall simply give the general results obtained by this method of treatment. Nearly all these cases were observed and were reported in detail by my chief of clinic, Dr. Christian.

In the salol series the drug was administered in the capsule form one hour after meals. Each capsule contained ten grains. The beginning dose was three capsules a day. This was increased within a week to six, nine, or even twelve capsules a day. In no instance was the stomach seriously deranged. Two patients suffered from serous diarrhœa; three patients from fever of forty-eight hours' duration, intense pain in the back, and smoky urine.

In all these cases discharge was free, but neither ardor urinæ nor chordee in their more severe forms were noticed. In all, running continued for more than six weeks, the discharge remaining free and distinctly purulent. At the expiration of this time, cure was effected by means of astringent injections, sometimes in combination with the use of a sound.

My general conclusion as to the result of salol treatment was that it modified the severity of the inflammatory symptoms, but did not shorten the attack of gonorrhœa.

The next series of cases was put on oleoresin of cubebs. This was given in 60- to 90-grain doses, according to the tolerance of the stomach. In a few cases 30 grains was the maximum dose. This medication seemed to exert no effect whatever upon the urethritis, excepting, perhaps, to slightly aggravate the inflammatory symptoms and to increase the ardor urinæ and chordee.

By the oil of sandal-wood, given in from 30- to 60-grain doses, depending upon the toleration of the stomach, the discharge was very materially modified. After the second or third day of treatment it was often cut down to half its former quantity, and the increasing and stationary stages were shortened by several days.

In two or three weeks the discharge was reduced to a single muco-purulent drop, which, in one-quarter of the cases, disappeared in from four to six weeks, leaving the patient permanently well. In the other cases cure was accomplished in the fifth and sixth weeks by astringent injections. No complications were observed in the administration of this remedy, excepting those due to disorder of the stomach. When nausea and eructations occurred, the

dosage was reduced by one-half, and in one or two days was slowly increased again.

The copaiba series gave about the same results.

In all these cases treated by salol and balsams, chordee and ardor urinæ received the customary treatment.

In summarizing the results it seems clear that copaiba and oil of sandal-wood are much more efficient than cubebs and salol, and that they very materially shorten the period of acute inflammation. Salol, in the few cases observed, exerted no markedly beneficial effect, excepting that the cases ran a mild and uncomplicated course. Since this drug is excreted in the form of carbolic acid, it is clear that it must act as a feeble antiseptic to the mucous membrane; hence it is possible that it may prove serviceable in preventing inflammatory complications. This point can only be determined after observation of a very large number of cases. Cubebs seemed absolutely without value.

On the basis of these observations we have been using in the hospital service a capsule containing five minims of balsam of copaiba, five minims of oil of sandal-wood, and one minim of oil of cinnamon. The combination of the two balsams seemed to act more favorably than either alone, and the addition of the aromatic renders them more acceptable to the stomach. Of these capsules, six to twelve a day are administered one hour after meals.*

Of one hundred and fifty cases treated by mouth medication alone, one hundred and thirty-four were uncomplicated, twelve developed the typical symptoms of acute posterior urethritis, and four suffered from epididymitis. Considering the fact that these were all ambulant dispensary cases,—a class notorious for their disregard of general hygienic directions,—this absence of complications is fairly satisfactory.

Experience in former years in a very large number of cases had conclusively shown that injections administered early were much more liable to be followed by complications such as violent posterior urethritis, epididymitis, and prostatitis, than when the local treatment was postponed until the disease has reached its subsiding stage. These injections were, however, mainly made up of the astringents, and were often given of a strength now recognized as undesirable in the acute stages of inflammation.

* The drugs employed in these studies were supplied by Parke, Davis & Co., and were of approved purity and strength.

Of one hundred and fifty cases thus treated, eighty-five were complicated by severe posterior urethritis, and in thirteen epididymitis developed.

In starting anew to consider the value of injections, the following methods were tried:

1. The abortive treatment by means of strong solutions of nitrate of silver.

2. The abortive treatment by copious flushings with dilute antiseptics,—bichloride of mercury, 1 to 20,000; permanganate of potassium, 1 to 10,000; nitrate of silver, 1 to 10,000 to 1 to 15,000.

3. Injections of bichloride of mercury, 1 to 20,000; or nitrate of silver, 1 to 6000 to 1 to 10,000, administered from the beginning of the attack.

4. Antiseptic and astringent injections administered in the late subsiding stages.

The abortive method by means of strong solutions of nitrate of silver was tried in eight cases. These were selected in accordance with the rules laid down by Diday,—*i.e.*, that the case should be seen before the gonococci had penetrated deeply, the discharge being slight, and made up mainly of mucus and epithelium, and inflammatory phenomena being absent. This, of course, implied that the disease should be seen in the first twenty-four or forty-eight hours of its onset, though in some cases inflammatory phenomena become so marked in twelve hours that attempts to abort the disease are contraindicated.

In making these injections the patient was first required to urinate, stopping the stream repeatedly by pressure upon the meatus, and thus more thoroughly flushing out the fossa navicularis. The urethra was compressed one and a half inches behind the meatus to prevent the injecting fluid from flowing farther back than this, and the fossa navicularis was distended three times with a ten-per-cent. solution of nitrate of silver.

As a result of these injections there was a discharge of pus and blood for twenty-four to forty-eight hours, and the patient suffered from marked ardor urinæ. In seven of the cases the gonorrhœal nature of the inflammation was determined before injection by means of microscopic examination. In the eighth case the discharge was not examined immediately, since, from the history of the case, it seemed clear that the inflammation was undoubtedly gonorrhœal in nature. On the day following the treatment, examination of the pus taken before injection showed that no gonococci were present, the case being undoubtedly one of irritative urethritis.

Of the seven remaining cases, four were well in seven to ten days, and remained so for many weeks afterwards. They were then lost sight of.

Microscopic examination of the post-injection discharge of those cases ending in prompt recovery failed to show gonococci.

In the remaining three cases the disease was very slow in reaching its florid stage. In two, on the day following injection, no gonococci could be found in the discharge. Two days later the discharge was extremely slight, but careful and prolonged examination showed one or two pus-cells containing gonococci. At the end of a week, without further treatment, the discharge was still slight and the gonococci not numerous. At the end of two weeks gonococci were numerous and discharge abundant. Irrigation treatment was then adopted, and the cases quickly convalesced. In the third case no gonococci appeared in the discharge until the fourth day. Irrigations were then practised, resulting in complete cessation of discharge. After these irrigations were discontinued, however, at the end of two weeks the discharge again appeared, and continued to appear at intervals for four months. This patient had three previous attacks of gonorrhœa and was suffering from stricture, which he refused to have dilated.

Out of seven cases of true gonorrhœa the Diday abortive injection was successful in four; in the remaining three it in no wise complicated or aggravated the subsequent development of the disease. Indeed, it seemed to render the backward extension of inflammation much slower than is ordinarily the case.

Antiseptic injections practised from the first were employed in thirty cases. The drugs used were nitrate of silver, 1 to 6000 to 1 to 12,000; and bichloride of mercury, 1 to 12,000 to 1 to 20,000. Either the ordinary gonorrhœa syringe or the rubber bulb was employed. Injections were given twice daily,—night and morning. When the nitrate of silver was employed, the urethra was flushed out two or three times at each injection. Only in this way could the full effect of the application be obtained, since, in dilute solutions, the small quantity of urine remaining in the urethral walls is sufficient to neutralize the amount of silver contained in the injection solution. When the bichloride of mercury was employed, the patients were instructed to flush out the urethra from six to ten times at each injection.

As a result of this treatment, the discharge was rapidly cut down, and usually both ardor urinæ and chordee were favorably influenced. In six cases the injections had to be discontinued temporarily during the second or third week on account of symptoms of acute posterior urethritis. This subsided in three or four days, and the injections were continued, and were later supplemented by the astringents. One case developed epididymitis. The general results obtained from this treatment were that acute posterior urethritis developed more frequently than when internal treatment alone was employed during the increasing stage of the disease, but that the anterior discharge was more markedly influenced than by balsams alone.

Copious irrigations were given by means of a rubber bag holding one quart, the tube of which was attached to a soft catheter of No. 10 size. This catheter was lubricated with carbolized glycerin and passed to the compressor urethræ muscle, the bag was elevated four feet above the level of the bladder, and its contents were allowed to flow through the catheter, thus flushing out the anterior urethra. The lotions employed were as hot as could be borne with comfort by the patient. The nitrate of silver was during the early stages usually too irritating. The solution of choice was bichloride of mercury, 1 to 20,000, with enough sodium chloride added to make a solution about equal in density to normal blood serum (about .7 per cent.). In some cases this also seemed to irritate. Permanganate was then used, and usually excited no inflammatory reaction. The irrigations were employed as soon as the patient came under observation. In the increasing stage they were given night and morning, if possible. Usually they could only be taken once a day. The passage of the catheter was rendered painless by previous injection with a four-per-cent. solution of cocaine.

Twenty cases of acute urethritis were thus treated. As a result, the gonorrhœa, almost without exception, ran an unusually mild course. Often in three to five days discharge would cease entirely, and even in the clap shreds found in the urine but few gonococci could be detected. In three cases cessation of the treatment at the end of two weeks showed that the patient was permanently cured. Usually there would be some moisture at the meatus in the morning. Examination of the urine would show the presence of clap shreds, but gonococci could not be found. In no instance was ardor urinæ or chordee particularly distressing. In five cases mild symptoms of posterior urethritis developed. In the sixth case the pain and tenesmus incident to involvement of this portion of the urethra became intense,

persisted for five days, was not beneficially modified by almost toxic doses of anodynes, and only yielded to instillations of two-per-cent. nitrate of silver. In the majority of cases the morning moisture and clap shreds persisted for from four to six weeks, and only disappeared after the employment of astringent injections by means of the ordinary piston syringe, or of instillations into the prostatic urethra. It was noted in a number of cases that even though the outflow of the injected liquid from the urethra was comparatively free, nevertheless the compressor urethræ muscle yielded to the pressure of the lotion and allowed some of this to pass into the bladder. This can scarcely be considered a contraindication to the employment of this method, since it may be accepted that gonorrhœa always invades the posterior urethra, but usually in a form so light and superficial that it is not noticed. This being the case, mild antiseptic lotions applied to this part of the urethra are particularly desirable. These copious flushings were often extremely painful, the distress lasting for one or two hours after they were completed.

The irrigation treatment in the few cases observed gave better results than any other method. Though it did not always greatly abridge the course of gonorrhœa, it materially modified the violence of the inflammatory phenomena. In cases where there was no stricture or other lesion from preceding gonorrhœa it sometimes accomplished a cure within two or three weeks.

The employment of astringent injections during the early subsiding stage of gonorrhœa showed that acute symptoms of posterior urethritis were even more liable to occur than when mild antiseptic injections were employed from the first. This would naturally be expected, since during the end of the second week the inflammation has reached its greatest intensity at the bulbo-membranous junction, and has in nearly all cases already invaded the membranous and prostatic urethra. Any strong irritant applied to the anterior urethra would, by markedly increasing congestion of the whole of this canal, acutely exacerbate a mild posterior urethritis. In the late subsiding stage, however, six to eight weeks, injection treatment, properly applied, produced only beneficial effects.

The injections employed were:

℞ Silver nitrate, gr. ss to i;
Distilled Water, f℥vi.

℞ Colorless fluid extract of hydrastis, f℥iv;
Subnitrate of bismuth, ℥iv;
Rose-water, f℥vi.

℞ Sulpho-carbolate of zinc, grs. xv to xxx;
Distilled water, f℥vi.

℞ Powdered alum, ℥i;
Water, f℥vi.

℞ Carbolic acid, grs. vi to xii;
Zinc sulphate, grs. xv to xxx;
Distilled water, f℥vi.

Hydrastis and zinc seemed particularly serviceable towards the end of the subsiding stage. The bismuth and hydrastis injection seemed the best with which to begin injection treatment.

In addition to the methods above detailed, we have tried on four dispensary cases injection of ergot, led thereto by many and enthusiastic reports as to its almost specific action in inhibiting the growth of the gonococci. We employed a five- to twenty-five-per-cent. solution. The results were absolutely negative.

Ichthyol was also used as an injection in one- to ten-per-cent. solution, but no marked benefit was derived from its application. It would be particularly in acute inflammatory cases that this drug should be most serviceable, since its special value lies in its power to inhibit germ growth and the quality it has of causing absorption of subepithelial infiltration.

The method of Cotes and Slater was tried in seven cases. This method was carried out as follows: After the patient urinated, the urethroscope was passed to just beyond the posterior margin of the acute inflammation. The urethra was cleansed and dried by the application of cotton, and then was medicated by means of a cotton applicator soaked in a ten-per-cent. solution of nitrate of silver brought in contact with the entire length of the urethra. Following this, alkaline mixtures were given internally, and a mild antiseptic injection was used daily. Our results by no means correspond to those reported by Cotes and Slater, who were successful in forty cases, curing the disease on an average in about twelve days. The applications always caused severe ardor urinæ, and in two cases seemed to be the exciting cause of acute posterior urethritis. The disease was not aborted in any case. The best results were those which we could naturally expect from the use of the mild antiseptic injections applied after the cauterant treatment. Two of the cases ran into gleet.

Concerning the conclusions which this series of observations seemed to justify, the following is a *résumé:*

1. The abortive treatment of gonorrhœa by means of ten-per-cent. nitrate of silver injections applied to the navicular fossa is advisable when the disease is seen in its earliest stage,—that is, when inflammatory phenomena are absent, and when the symptoms consist in the slight whitish discharge and tickling or moderate burning on urination, and when microscopic examination of the discharge shows that it is made up mainly of mucus and epithelium containing little pus. This abortive treatment is successful in an uncertain percentage of cases. When it fails, it does not materially complicate the subsequent course of gonorrhœa.

2. When gonorrhœa is first seen in its florid stage, in addition to ordering rest, light diet, regular evacuation of the bowels, free drinking of plain waters, hot baths on retiring, alkaline diuretics, and the treatment appropriate to ardor urinæ and chordee, balsams should be given in full dose and mild antiseptic irrigations or injections should be practised at once. The most efficient balsams are sandal-wood and copaiba. These should not be pushed to the point of disordering the stomach.

3. Irrigation of the urethra by means of hot antiseptic lotions gives better results than any other treatment. These should be continued either once or twice a day until gonococci disappear from the discharge or from the clap shreds found in the urine. They should then be replaced by astringent injections.

4. When irrigations cannot be employed, even during the florid stage injections are indicated; these should be of bichloride of mercury, 1 to 20,000, or nitrate of silver, 1 to 10,000. These injections should be gradually strengthened as urethral tolerance is established.

5. Injections of nitrate of silver, 1 to 3000, or bichloride of mercury, 1 to 1000, or injection Brou, or any of the formulæ customarily used in practice in the increasing or florid stage of gonorrhœa, distinctly predispose to the development of hyperacute posterior urethritis, epididymitis, and other complications of gonorrhœa, and may aggravate and prolong urethral inflammation. Strong astringent injections employed in the early period of the subsiding stage are equally dangerous.

6. Treatment by internal medication alone is followed by a small percentage of epididymitis and posterior urethritis, but by slow cure. The most efficient treatment consists in the combination of the balsams with local antiseptic washings.

PILOCARPINE: ITS PHYSIOLOGICAL ACTION AND THERAPEUTIC USES. WITH EXHIBITION OF SPECIMENS SHOWING CHANGE IN THE COLOR OF THE HAIR.

READ BEFORE THE NEW YORK ACADEMY OF MEDICINE BY INVITATION, APRIL 5, 1893.

BY D. W. PRENTISS, M.D., WASHINGTON, D. C.

THE drug which I have selected to bring to your attention this evening is the most important addition to the Pharmacopœia of 1880, and is one that has interested me for several years past.

In one particular its action is unique, and is confined, so far as I know, to my own experience. I refer to the action of pilocarpine in changing the color of the hair.

This action of the drug alone, however, is too limited for general interest, and the title of the paper is made to read "Pilocarpine: Its Physiological Action and Therapeutic Uses. With Exhibition of Specimens showing Change in the Color of the Hair."

I am warned that this essay must not be too long, and therefore shall try to condense it as much as possible.

DIVISION OF THE SUBJECT.

1. *Brief Statement of Natural History.*
2. *Physiological Action.*
   1. As a sudorific.
   2. As a stimulant to accommodation of eye and contraction of pupil, and as stimulant to the hearing apparatus.
   3. As a stimulant to the growth of the hair,—action in changing color of hair.
3. *Therapeutic Uses.*
   1. Most important as a sweat producer.
   2. In diseases of the eye and ear.
   3. Use in promoting growth of the hair.

1. *Natural History.* — (Pharmacographia), *Pilocarpus pennatifolius*, Lemaire.

A shrub, growing to height of ten feet; native of the eastern provinces of Brazil. (For plate, see Bentley and Trimen, Part XXXII., 1878.)

There are other species included under the general name of jaborandi, but the *pennatifolius* is the most active and the one recognized by the U. S. Pharmacopœia.

The principal constituents of the leaves are:*

* Through the kindness of Merck & Co., of New York, specimens of the pure alkaloids and their salts were exhibited.

1. *Pilocarpine*, the active principle.

2. *Jaborine.*

3. *An essential oil*, which shows in the pellucid spots of the leaves and belongs to the terebene series.

Pilocarpine is an amorphous soft amber-colored mass, discovered in 1875 by Hardy, and makes crystallizable salts with acids. Leaves contain one-half of one per cent.

Jaborine has the same chemical constituents, but differently arranged, and gives just the opposite physiological action to pilocarpine. The action of jaborine is identical with atropine.

Hence the importance that the pilocarpine be pure and free from admixture. This admixture probably explains the different results obtained by different investigators as to physiological action.

The essential oil is inert.

2. *Physiological Action.*

1. As a sudorific.

Perhaps the shortest and least tiresome method of describing its physiological action will be to mention an actual case,* and as this is the case in which the change in the color of the hair occurred, it will be the more appropriate. It also illustrates the use of the drug in uræmia.

The patient, female, aged twenty-five years, was suffering from pyelo-nephritis with prolonged anuria. For ten weeks the amount of urine did not average two ounces daily, and this contained offensive pus. At one time—from December 16 to 23, seven days—not a drop was passed, although the catheter was used twice daily.

Again, from January 22 to February 2—eleven days—not a drop was excreted, the catheter still being introduced twice daily; and from January 22 to February 12—twenty-one days—a total of but little over two ounces in all were passed. Twenty-one days of almost total *anuria*.

Previous to December 16 the hot bath and hot packing were several times resorted to to produce diaphoresis, without effect.

Extreme uræmic symptoms had developed,—no itching, but incessant vomiting, nervous restlessness, twitchings of the muscles, flushed face, severe headache, confusion of vision, and delirium.

An attempt was made to give infusion of jaborandi by the stomach, but it was rejected, as was also the solid extract in gelatin-coated pills.

Finally, December 16, hydrochlorate of pilocarpine, 1 centigramme, was administered hypodermically, the patient being wrapped in a warm blanket, with bottles of hot water around her.

On two or three occasions later, when the blanket and hot bottles were omitted, there was less sweating.

From December 16 to February 22 twenty-two sweats were administered, requiring thirty-five or forty centigrammes of pilocarpine. As the patient became accustomed to the medi-

* *Philadelphia Medical Times*, July 2, 1881.

cine, it was found necessary to increase the dose to two centigrammes.

An analysis of the phenomena following the use of the drug in one of these "sweats," it seems to me, will be more graphic than a general description of the physiological action. If it is tiresome, I crave pardon. It shall, at least, be brief.

A Pilocarpine Sweat, 1 Centigramme Hypodermically.—The action of the drug was carefully noted. Immediately, almost before the needle was withdrawn, the face and neck would flush bright red, and dimness of vision be noticed; then palpitation. In three minutes, slight nausea; eyes, nose, and mouth beginning to water and skin showing moisture. In seven minutes, free vomiting, profuse sweating, and salivation.

ANALYSIS OF SEPARATE SYMPTOMS.

Perspiration.—First noticed on forehead and neck, then the skin of the whole body, which had been previously dry and harsh, became moist. When sweating was fully established, the water ran in little streams over all parts of the body. In the face it was with difficulty kept out of the eyes. In five minutes the hair would be saturated, and though wiped as dry as possible, it would be again soaked in a few minutes. In odor the perspiration was offensive, and on several occasions had a distinctly urinous smell.

Salivary Glands.—In the beginning of the ordeal water flowed freely from the eyes and nose, as well as from the mouth, but when salivation was fully established, the eyes and nose ceased to discharge. The saliva was viscid and tenacious, so that to clear the mouth it was necessary to use a handkerchief. Its flow was so profuse that, after thus clearing the mouth, she would not have time to get a drink to quench thirst before the mouth would again be filled. So, also, talking connectedly was prevented by the same cause. The water drank during a sweat at no time exceeded a gobletful.

Vomiting.—The vomiting continued throughout, almost without intermission, and was the most distressing symptom of the ordeal. After a spell of vomiting, the patient would lay back on the pillow exhausted, hoping for a rest, but it would immediately return. The odor of the ejecta during February was very offensive, like decayed vegetable matter.

The amount discharged in this way, which included saliva, was never less than two quarts, and often a gallon. The patient stated that she did not swallow the saliva, and insisted that the material vomited came from the stomach. This would indicate that pilocarpine also causes a fluid discharge from the gastric mucous membrane. Nausea and vomiting ceased as soon as the effect of the medicine passed off. Food was then taken and retained, although previously the stomach rejected everything.

Bowels.—Just as soon as perspiration was fully established the bowels moved,—always a large action, and sometimes more than once. This action on the bowels is twofold: (1) from an increased amount of liquid in the intestines and (2) from increase of peristaltic action. There were seldom more than two or three movements.

Action on Heart.—Pulse became rapid in a few minutes, and when the action of the drug was fully established, a thumping palpitation added to the distress occasioned by the vomiting. This "thumping" could be heard at a distance of six feet, and continued with decreasing violence until the close of the paroxysm. The pulse ranged from 120 to 136, and was weak and compressible.

Eyes.—Pupils contracted to a small point. Sight became impaired at the first rush of blood to the face, and the dimness continued until it was impossible to distinguish objects beyond the foot of the bed.

As the effects wore off the exhaustion was extreme; pulse 130 and feeble. But there was a grateful sense of relief, and a disposition to sleep even before the sweating ceased. The head was no longer dizzy, pain less, stomach free from nausea, and tongue free from coating. A quiet sleep followed, lasting several hours, from which the patient awakened refreshed and hungry.

Amount of Fluid discharged during a Sweat.—Of course, this could only be estimated. The fluids from acts of vomiting were caught in a basin and emptied three or four times, and each time contained not less than a quart. The blanket in which the patient was wrapped was saturated, as was also a folded sheet under the blanket. The pillow was saturated and the bolster beneath wet.

An experiment was made of saturating the blanket to as near as possible the same extent, and five pints of water were required.

Putting these together, then, we have the following calculation:

	Pints.
By vomiting and saliva.....	7
By saturated blanket.....	5
By sheet, pillow, and body-clothing.....	2
	14

This seems almost incredible, but I believe the amount is strictly within the truth. The patient and her attendants thought the amount understated rather than exaggerated.

It is unnecessary to record further the details of this case, as I have used it in illustration of the action of pilocarpine.

Suffice it to say, the patient recovered, and is alive to-day.

It only remains in this case to record the remarkable change in the color of the hair which took place under the influence of the pilocarpine.

All of the patient's life (she was twenty-five years old) up to the beginning of the treatment her hair was light blonde with a yellow tinge. Twelve days after beginning the injections it was noticed to be darker, and from that time the change of color was rapid until, two months later, it was black.*

The hair also became coarser and thicker in its growth. The eyebrows and eyelashes, before almost invisible, came out beautifully pencilled. The hair on other portions of the body participated in the change.

Modus Operandi of Pilocarpine.

Upon sweat and salivary glands:

1. Stimulates nerve-centres of these glands.
2. Stimulates efferent nerves to the glands.
3. Stimulates glandular structure itself to increase the secretion.

In brief, pilocarpine is a specific diaphoretic and sialagogue by its elective action on these glands.

It increases also the secretions from the mucous membranes of the

Bronchial tubes,
Stomach,
Intestines and kidneys,

But does not increase the flow of bile.

As to the discharge from the bronchi, stomach, and intestines, it is difficult to say how much of the liquid is swallowed saliva.

There is not time in this paper to go into details of the experiments made to show the manner of the action of this drug, nor is it necessary, since they are fully discussed in the works of H. C. Wood, Lauder Brunton, Ringer, and others.

Brunton speaks of the enormous secretion from the sweat-glands, and states that it amounts to from one to two pounds, and, together with the salivary secretion, often as much as eight pounds.

In the case which I have mentioned above I have estimated the amount, including the vomiting, at fourteen pounds.

I expect to have this statement challenged, and admit that it appears incredible that a girl weighing ninety or one hundred pounds could thus lose one-fifth of her weight in six hours without serious consequences. But the estimate was honestly made, and I stand by it.

Landois and Sterling give the amount of blood in the body at one-thirteenth of the body-weight, and the total proportion of water to the weight of the body at 58.5 per cent. It is not to be supposed that all the water excreted during a pilocarpine sweat comes from the blood at one time. As it is taken out of the blood it is replaced from other tissues by reabsorption.

One important point in the diaphoretic action of pilocarpine is the fact that the amount of urea excreted by the skin is greatly increased. This amount is stated to be not less than one gramme (fifteen grains) for each "sweat," which is five times more than in normal perspiration (H. C. Wood).

The importance of this fact is recognized in the usefulness of pilocarpine in uræmia, and is markedly illustrated in the above case. After three or four days of anuria, uræmic symptoms became intense, and were relieved by pilocarpine.

The discharge from the bronchial mucous membrane is largely increased. This also has an important clinical significance in two ways:

1. It is this effect that makes it useful in the treatment of diphtheria, in which disease it detaches and softens the membranes by the liquid exudation beneath them, so that they can be expelled. This statement is not theoretical, but is a clinical fact, and were it not for the depressing action of the drug on the heart, it would undoubtedly be of great value in that disease.

2. The second clinical significance of this action on the bronchial mucous membrane is that it points out a contraindication, as in cases where bronchitis or œdema of the lungs exists there is danger of drowning the patient in his own secretions.

But whatever may be the physiological action, as shown by experiments on animals, the clinical effect on the heart constitutes the main contraindication and principal danger of its use in disease. Many cases have occurred where fatal results from cardiac failure have followed its use in disease.

One notable case occurred in Dublin, Ireland, some years since, where a physician ad-

* Specimens were exhibited showing changes as above described.

ministered pilocarpine in malignant scarlatina. The patient promptly died, and the doctor was called upon to defend an action at law for having killed the child.

A similar case came under my own observation, without, however, the unpleasant sequel.

So, also, in dropsy with weak heart, especially dropsy *due* to heart-disease, care must be taken, in the use of the remedy, to administer stimulants freely at the same time.

Action on respiration follows that on the heart, dyspnœa accompanying the intense palpitation, and later there may be embarrassment from accumulation of mucus in the bronchial tubes. Temperature falls 0.9° during sweating stage (Brunton).

Another action of pilocarpine, which is mentioned only as a caution, is its effect in producing abortion. This is a frequent result where given in full dose during pregnancy. In like manner, also, it may produce premature menstruation or precipitate menorrhagia.

Bartholow mentions four cases in which labor was induced by three hypodermic injections of two centigrammes each; and out of nine cases where it was used for this purpose, it was successful in six.

General Diseases in which Pilocarpine is Useful.

1. *Dropsies.*	Of renal origin.
	Of cardiac origin.
	Local dropsies,—*e.g.*, hydrothorax.
	Hydropericardium and ascites.
2. *Uræmia.*	Anuria from various causes.
	In Bright's disease.
	Puerperal convulsions.
3. *Diseases of the skin.*	Especially such as are attended by dry, itching skin.
	Prurigo, pruritus senilis.
	Chronic urticaria, chronic eczema.

4. *Diphtheria.*
5. *Diabetes insipidus.*
6. *Galactagogue.*
7. *To stimulate the growth of the hair.*
8. *As an antidote to serpent venom.*

1. *In dropsies* its value is evident from the amount of liquid excreted from the system.

In renal dropsy and in local dropsy, such as hydrothorax, its value is particularly marked.

In renal dropsy it relieves not only by taking water out of the system, thus causing its absorption, but also by the large excretion of urea it causes, thus relieving the uræmia, as in the case before quoted. Another effect, especially in acute nephritis, is to relieve congestion of the kidneys and restore them to action.

It is desirable in administering the drug to wrap the patient in blankets and surround him with hot bottles, to increase the diaphoresis, and if he is exhausted, give a stimulant.

In hydrothorax, hydropericardium, and ascites the same method is to be employed. In the former the results have been especially satisfactory. In dropsies due to heart-disease, special care must be taken to guard against the depressing action.

2. *Uræmia.*—Enough has already been said of its use in uræmia due to *anuria*, in the case quoted, to indicate its usefulness. In puerperal convulsions it has proved of great value.

3. *In diseases of the skin*, particularly those attended by itching and in which the skin is dry.

In one of the cases where it caused change of the color of the hair it was given successfully for the itching attending chronic Bright's disease, in dose of 20 to 30 drops of the fluid extract several times daily, for a year and a half.

It caused moisture of the skin and relieved the itching.

I have seen it give prompt relief in a case of obstinate urticaria after the usual remedies had failed. In this latter case there was a gouty rheumatic affection of the finger-joints, which disappeared while under its use.

In another case of rheumatic gout of the fingers it was given successfully. So, also, in subacute and chronic rheumatism of other joints that resist ordinary treatment, pilocarpine is worth a trial on the basis of aiding the excretion of effete material from the system.

In these cases it is given by the mouth, either in form of the fluid extract or of the alkaloid, just sufficient to cause moisture of the skin and slightly increased flow of saliva, and must be continued sufficiently long to get decided excretory action.

4. *In Diphtheria.*—Dr. Guttman, of Cronstadt, was the first to insist on the value of pilocarpine in this disease, and he claimed favorable results in a large number of cases. His observation was, not that it exerted any specific action in the disease, but that it loosened and softened the false membrane by its action on the mucous membrane beneath, so that the former was easily expelled.

Following his report, Lax reported ten cases treated by pilocarpine alone, all of which recovered.

Later, Dr. E. C. Wendt (*Med. Record*, April 9, 1881) reported three cases which recovered

under pilocarpine after other remedies had failed. On the other hand, Neumeister published twenty-eight cases thus treated, with unfavorable results. Five cases were adults, twenty-three children.

The adults appeared to be influenced favorably, but with the children, thirteen out of the twenty-three died, and in eight bad effects of the drug were observed.

Neumeister's conclusion was that pilocarpine is a dangerous drug with children, and that its value in diphtheria is not sufficient to justify its use.

In a disease so fatal as diphtheria, especially the laryngeal form, any remedy which promises to avert the usual termination is welcomed with avidity.

The following case illustrates the most favorable action of the remedy in this disease. It occurred in my practice shortly after Guttman published his cases.

I give only a synopsis of the case. Charles S., aged fourteen months, strong, healthy child of German parentage. Had been ailing for several days previous to July 9, 1881, with hoarse cough. On this date I saw him, when voice was lost, and he was restless.

July 10.—Breathing loudly stridulous; voice entirely suppressed; entire fauces were covered with ashy-white membrane.

July 11, A.M.—Worse; dyspnœa and restlessness increased. Pilocarpine, 2 milligrammes, ordered to be given every hour, milk-punch *ad lib.*

July 11, P.M.—No worse.

July 12, A.M.—No worse. Turpeth mineral emetic given during night; dose of pilocarpine doubled.

July 12, P.M.—Better; slept most of the day; stridulous breathing less marked; more cough and cough looser; sweating and salivation very free; dose of pilocarpine reduced to original amount.

July 13, A.M.—Still better; passed comfortable night, sleeping; stridulous breathing gone; false membrane has disappeared from the fauces.

July 13, P.M. — Still improving; cough troublesome, but loose; aphonia still present.

July 15.—Still improving; slight return of voice; some appetite.

July 18.—Diphtheria well; slight diarrhœa.

When I first saw this case I considered it hopeless in the light of previous experience. It illustrates the most favorable action of pilocarpine in diphtheria.

I have tried it in many cases since, but without so favorable a result.

The form of diphtheria in which pilocarpine is most useful is that known as membranous croup, in which the danger is from the local obstruction to respiration rather than from septic infection and exhaustion. In these cases it favors the separation of the membrane and consequent expulsion.

5. Diabetes Insipidus.—In this disease it acts as a revulsive by attracting away from the kidneys the excessive secretion of water and directing it to the skin and salivary glands; and the habit once broken, it may not return.

One case under my observation, a German blacksmith, aged about fifty years, had a sunstroke in July, which was followed in October by diabetes insipidus.

The amount of urine passed was very great, a large bucket being filled during the night, and as much more passed during the day,—about four gallons in twenty-four hours.

The amount of water drunk was in proportion. The skin was dry and scaly, though in health he had always sweated freely.

After trying other remedies without relief, he was ordered 4 grammes of the powdered leaves in infusion, the powder to be stirred up and drunk with the infusion at bedtime; at the same time the man was wrapped in hot blankets.

The following morning I found him much exhausted, unable to rise from weakness. He had sweated and salivated all night. The blankets were soaked, the mattress soaked, and there was a puddle of water on the floor under the bed. But it was the end of the polyuria; the latter never returned.

This case occurred over twenty years ago. There has been no return of the disease, and the man is still in good health for his age.

6. As a Galactagogue.—Its action upon the mammary gland is analogous to its action upon the salivary and sweat glands, but in a much less degree.

Many cases have been reported of its successful use when there was insufficient secretion of milk.

For this purpose it is administered internally in doses just sufficient to produce its physiological action without excessive sweating and salivation.

7. To stimulate the Growth of the Hair.—This it does by increasing its nutrition through the hair bulb. There are two methods of administration for this purpose,—one, the slow method, by small doses given by the stomach through a long period, in just sufficient amount to cause slight sweating and salivation; the other, the rapid method by hypodermic injections of one centigramme two or three times

a week. (See reports by Schmitz, Scholler, Simon, and Pick, farther on in this paper, p. 662.)

8. The Action of Pilocarpus as an Antidote to Serpent Venom.—For the knowledge of this property of the drug, we are indebted to Dr. H. C. Yarrow, of Washington, D. C., and late herpetologist to the United States National Museum.

The following letter from Dr. Yarrow explains itself:

"My dear Dr. Prentiss,—In answer to your inquiry as to the influence of extract of jaborandi as an antidote to serpent venom, I will state that my experiments at the United States National Museum at Washington, D. C., upon the venom of the rattlesnake, led me to believe that jaborandi has decided antidotal value, and its active principle, pilocarpine, doubtless would be even more efficacious. These experiments were carefully made upon dogs, rabbits, and chickens, and it was conclusively shown that jaborandi, administered hypodermically after the application of the venom, protected against an otherwise lethal dose. So, also, did the administration of the drug internally immediately after the poisoning. The details of these experiments were published in *Forest and Stream* for the year 1888.

"Very sincerely yours,

"H. C. Yarrow, M.D."

Action on the Eye.

Brunton divides myotics (pupil contractors) into two classes:

1. Those which act by stimulating the endings of the oculo-motor nerve, which supply the circular fibres of the iris,—viz., pilocarpine, muscarine, nicotine.

2. Those which act directly on the circular fibres themselves,—viz., eserine.

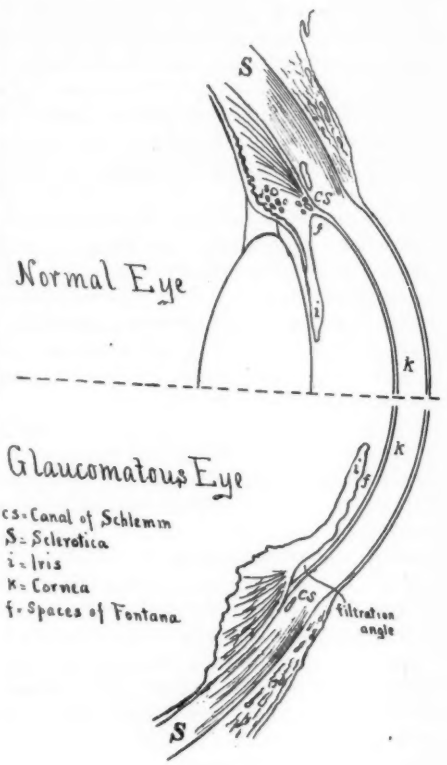
Pilocarpine contracts pupil and causes spasm of accommodation by stimulating the oculo-motor nerve-endings of circular fibres of the iris, and those to the ciliary muscle.

Action upon accommodation begins after, and passes away before, that upon the iris. The effect on the eye, when applied locally, lasts about one hour and a half.

Atropine, on the contrary, dilates the pupil and paralyzes the accommodation by paralyzing nerve-endings of the oculo-motor, and stimulating the radiating fibres of the iris.

The importance of these physiological actions is in their relation to intraocular pressure.

I hope I may be pardoned a reference to the therapeutics of certain eye-diseases in this presence, where so many are already familiar with the subject in their daily work. But all of us are not specialists, and the reference is in the line of *pilocarpine*.



Intraocular pressure is increased by the increase of fluid in the anterior chamber. As,—

1. An increase in the amount secreted by the ciliary processes (aquus capsulitis).

2. Interference with its exit through the canal of Schlemm into the perichoroidal spaces (glaucoma).

3. Hyperæmia of the iris.

Intraocular pressure is diminished by opposite causes. Pilocarpine and eserine diminish intraocular pressure by drawing backward and flattening the iris, so as to allow the fluid of the anterior chamber to escape through the spaces of Fontana and the canal of Schlemm into the perichoroidal spaces.

An examination of the drawing, which shows both the normal and the glaucomatous eye, indicates the *modus operandi* of myotics in diminishing intraocular pressure.

The diseases of the eye in which pilocarpine and other myotics are useful I will merely enumerate:

DISEASES OF EYE AND EAR IN WHICH PILOCARPINE IS USEFUL.

Diseases of Eye.	Glaucoma.
	Hemorrhage into vitreous and retina.
	Detachment of retina.
	Floating bodies in vitreous.
	Vitreous opacities.
	Commencing atrophy of optic nerve.
	White atrophy (a specific, according to Gillet de Grandmont).
	Paralysis of accommodation.
	Amblyopia from tobacco- or alcohol-poisoning (*par excellence*).
	Chronic rheumatic affections of eyeball.
	Photophobia.
	To break up adhesions of iris to lens or cornea.
Diseases of Ear.	Labyrinthine deafness.
	Aural vertigo.

I have mentioned *glaucoma* first because it is a matter of so much importance to the general practitioner that he should be able to recognize it, and at least do no harm if a case comes to him.

The majority of cases of glaucoma come first to the general practitioner, and the two symptoms—hardness of the eyeball and rainbow colors around a light—should put him on his guard. If these symptoms are present, with dimness of vision and pain, better send the case to a specialist.

But, of all things, do not put *atropine* in the eye. This last, unfortunately, is too often done, the case being mistaken for iritis, the result of which it is unnecessary to state to this audience.

In all of these diseases the pilocarpine is useful, from one or all of its properties, in (1) reducing intraocular pressure, or (2) contracting the pupils, or (3) stimulating the muscle of accommodation.

In commencing atrophy of the optic nerve, according to Gillet de Grandmont, it is almost a specific (Brunton's "Therapeutics").

In amblyopia from tobacco and alcohol also, it is credited with being a most valuable remedy.

When used only to contract the pupil and stimulate accommodation, it may be dropped into the eye in solution.

But when used in the graver internal diseases of the eye, it must be pushed to its full physiological action, and had best be administered hypodermically in dose of 1 centigramme, this being given once daily, or once in two or three days, according to the effect.

In labyrinthine deafness and aural vertigo, success has been claimed in several cases. It is administered as above. He does not explain the manner in which it acts.

ANTAGONISM BETWEEN PILOCARPINE AND ATROPINE.

This is so well known that it needs but to be mentioned.

Pilocarpine causes sweating and salivation and increases secretion of mucous membranes; contracts pupil and stimulates accommodation; diminishes intraocular pressure.

Atropine and jaborine are the opposite in every particular.

The two are, therefore, physiological antidotes of each other.

A pilocarpine sweat can be stopped by a hypodermic injection of atropine. In experiments on frogs, where the action of the heart has been stopped by pilocarpine, it can be restored by atropine.

So, also, poisoning by belladonna, stramonium, or hyoscyamus can be, and has been, successfully treated by pilocarpine. Such cases have been mentioned by several writers.

A case is reported in the *Australia Medical Gazette* (February 15, 1892, by Dr. Cortis) of a child, eighteen months old, who took four grains of sulphate of atropine and six grains of cocaine. Pilocarpine, one-seventh of a grain, was injected, and shortly after repeated. There was immediate improvement and prompt recovery.

The amount required to antagonize a given dose of atropine is stated to be four times as much of pilocarpine.

In the three following respects pilocarpine and atropine agree in action:

1. In producing frontal pain.
2. In producing pain in bladder.
3. In affecting children less than adults in proportion.

But these have no importance from a therapeutic stand-point.

We consider next the change in the color of the hair.

One case I have above referred to.

In another, a case of diphtheria in a very light-haired child, specimens taken before and after treatment show a decided change for the darker; but after a time the color appeared to fade. In this case the drug was only administered a few days.

A third case was reported in a paper read by myself before the American Medical Association, June, 1889, which I draw upon largely for the following facts:

Mrs. L., aged seventy-two years, suffering from Bright's disease, contracted kidney. Hair and eyebrows had been snow-white for twenty years. Suffered greatly from itching of the skin, due to the uræmia of the kidney-disease. Skin harsh and dry. For this symptom fluid extract of jaborandi was prescribed, with the effect of relieving the itching. It was taken in doses of 20 or 30 drops, several times a day, from October, 1886, to February, 1888.

During the fall of 1887 it was noticed by the nurse that the eyebrows were growing darker, and that the hair of the head was darker in patches. These patches and the eyebrows continued to become darker, until, at the time of her death, they were quite black, the black tufts on the head presenting a very curious appearance among the silver-white hair surrounding them. A new growth of black hair also appeared on the scalp under the old hair.

These are the only cases thus far recorded in which pilocarpine has been supposed to change the color of the hair.

In 1879, Dr. G. Schmitz (*Berliner Klinische Wochenschrift*, No. 4, 1879; *Medical Bulletin*, Philadelphia, 1882), of Cologne, reported two cases in which pilocarpine stimulated the growth of the hair in alopecia. One patient, aged sixty, completely bald. Pilocarpine subcutaneously for disease of the eye. After three injections, within a fortnight, the head became covered with a thick down, which grew rapidly, so that in four months no trace of the baldness was left. No mention is made of the color. In the second case, the patient, aged thirty-four, had a bald patch on top of the head the size of a playing-card. Total restoration of the hair after two injections, in a short time.

Scholler (*Klebs's Archiv*, 1879) tells of similar results in animals in which alopecia had been produced by injections of bacteria.

Oscar Simon (*Berliner Klinische Wochenschrift*, 1879) relates the case of a woman, aged thirty. General alopecia,—head, eyebrows, eyelashes, axillæ, and pudenda. In a few weeks, after twenty injections of pilocarpine, the lanugo of the whole body was restored. In other cases so treated there was no effect whatever.

Professor Pick (*Vierteljahrschrift für Dermat. und Syphil.*, 1880) relates the case of a man who was afflicted with alopecia areolata. Two weeks after pilocarpine injections followed a fine colorless lanugo, and in twelve weeks restoration of the hair.

Ten cases of alopecia pityrodes; favorable results from same treatment. Color of hair not mentioned.

Landesberg (*Medical Bulletin*, Philadelphia, 1882), of Philadelphia, says that in more than one hundred cases of eye-disease treated by pilocarpine he observed no effect whatever upon the growth of the hair. Dose and mode of administration not mentioned.

In 1882, Julius Pohlman, of Buffalo, experimented on white rabbits by hypodermic injections of pilocarpine. The dose used was large,—1 grain three times a day. No change in color was noted in pure white rabbits. In parti-colored animals,—white and brown,—in one a brown spot on back of head deepened and spread to a remarkable degree down the back and sides of the animal to the legs. In other individuals no change was noticed. Post-mortems on these animals showed enlarged spleen and altered suprarenal capsules.

The question of change of color of the hair is an interesting one, both from a physiological point of view and from the practical one of pathology.

The physiological aspect embraces the question of how a change of color takes place,—whether in existing hairs, or produced by shedding of the hair and a new growth taking its place of a different color.

It has been doubted by good authority—Hebra and Kaposi—if the hair, after being once developed, can change except by a very gradual process. This doubt is based upon the theory that the hair has no vascular or nerve-connection with the general system, and must, therefore, be independent of nervous or systemic influence. This position is, however, not tenable. The clinical evidence is positive that the hair does change color under systemic influences, sometimes gradually and sometimes suddenly.

We hear frequently of the hair turning white in a night from violent emotions, as fright, great grief, or great joy, and it has come to be a method of expressing extreme emotion to say, "It was enough to turn one's hair white."

I say it is not an uncommon thing to see mention of such cases in popular literature, but well-authenticated cases are not so often found. It is recorded in history that the hair of Marie Antoinette and Mary Queen of Scots became white suddenly from the horrors to which they were subjected.

A short time since, in conversation with an

eminent microscopist and pathologist,* I asked how he would explain, from the basis of minute anatomy, the sudden change in color of the hair. He replied that he did not explain it; that he did not believe it happened; that the reported cases were not authenticated. He further said that, from the structure of the hair and its relation to the skin, he considered it impossible.

Duhring (third edition) is authority for the statement that Hebra and Kaposi discredit sudden canities. There is, nevertheless, no doubt of the fact that such change does sometimes occur, and to set the matter definitely at rest, I looked up the subject in the library of the Surgeon-General's office. The following are some of the references found:

Dr. Wm. P. Dewees ("Phila. Med. Mus.," 1807, vol. iii. p. 219), of Philadelphia, reports a case of puerperal convulsions under his care. From 10 A.M. to 4 P.M. fifty ounces of blood were taken. Between the times of Dr. Dewees's visits—*not more than an hour*—the hair anterior to the coronal suture turned white. The next day it was less light, and in four or five days was nearly its natural color.

He also reports two cases of sudden blanching from fright.

Dr. Robert Fowler (London *Lancet*, 1853, p. 556) reports the case of a girl sixteen years of age, apparently in good health, hair black; found one morning, in combing her hair, that a strip the whole length of the back hair was white, starting from a surface two inches square around the occipital protuberance. Two weeks later she had patches of ephelis over the whole body.

In the *Canada Journal of Medical Science*, 1882, p. 113, is reported a case of sudden canities due to business worry. *Microscope showed a great many air-vesicles both in the medullary substance and between the medullary and cortical substances.*

Dr. Graves says most authors are of the opinion that the hair, once formed, is independent of the organism, with which opinion he disagrees, instancing *Plica Polonica* as opposed to such a theory. He states five cases sustaining his views. (See *Dublin Quarterly Journal, of Med. Sci.*, 1847.)

In the *Boston Med. and Surg. Journ.*, 1851, is reported a case of a man, thirty years old; hair scared white in a day by a grizzly bear. Was sick in a mining-camp; was left alone, and fell asleep. On waking found a grizzly bear standing over him.

A second case. Man of twenty-three years was gambling in California. Placed his entire savings of eleven hundred dollars on the turn of a card; was under tremendous nervous excitement while the cards were being dealt. He won. The next day his hair was perfectly white.

In the same article is the statement that the jet-black hair of the Pacific islanders does not turn gray gradually; but when it does turn, it is sudden, usually the result of fright or sudden emotions.

The following cases are of change of color from white to black:

Dr. Bruley (*Boston Med. and Surg. Journ.*, 1852, p. 406), physician to the Fontainebleau, reported to the Société Médicale, Paris, in 1798, the case of a woman, sixty years old, whose hair, naturally white and transparent as glass, became jet black four days before her death (phthisis). On examination after death the bulbs of the black hairs were of immense size and engorged with dark pigment. The roots of white hairs that remained were dried up and two-thirds smaller in size (Wilson, "Skin-Diseases," p. 377).

Dr. Alanson Abbé (*loc. cit.*) mentions the case of Dr. Capen, who had become gray; but, on recovery from disease, his hair became quite dark.

In the *St. Louis Med. and Surg. Journ.*, 1845, p. 310, there is reported the case of an old man, eighty-one years of age, robust and hale. Hair, from being perfectly white, became black; same of the beard. This man also presented the phenomena of second sight; could read readily without glasses.

The text-books on skin-diseases also mention cases. Several cases of sudden canities are referred to in Ziemssen.

Brown-Séquard, in his own person, noticed one day a white hair in his beard where there was none the day previous. He pulled it out, and the next day others appeared.

This was observed repeatedly, and there was no doubt that the hair in its entire length turned white in one night. Under the microscope these white hairs showed small *air-bubbles in place of the normal pigment.*

In a case of hemiplegia, the hair became white on the paralyzed side. The same has been reported in cases of neuralgia.

Other anomalous cases have been noted where the hair became white in patches, and where individual hairs have been seen alternately white and black at different stages of its growth, to which condition Karsh and Landois have given the name of "ringed

* Dr. William M. Gray, Army Medical Museum.

hair," and ascribed it to an intermittent trophic disease affecting the hair-follicle.

Wilson mentions a case where the hair was gray in winter and regained its normal color in summer.

Alibert (*loc. cit.*) and Beizel relate cases of women with blonde hair which all came out after severe fever, and when new hair grew, it was black. Alibert also relates the case of a young man who lost brown hair during illness, and that which replaced it was red. In the case of an epileptic girl of idiotic type, with alternating phases of stupidity and excitement, during the stage of stupidity the hair was blonde; during excitement it was red. This change of color took place in two or three days, the change always beginning *at the end of the hairs*. Pale hairs showed an *increased number of air-spaces*.

It has been frequently observed that when the hair changes color gradually, the change begins in the end and extends towards the bulb.

In conversation with an eminent ornithologist* on the change of color in the plumage of birds, he said, "I have lately been watching hairs in my moustache turn gray, and it always begins at the ends and extends to the roots."

Speaking on the subject with a lady (the one who furnished the specimens here shown), she mentioned the case of the physician who attended her at the sea-shore some years ago. The doctor's hair was long and quite gray. One day he came in to see her after having his hair cut, and she was surprised to notice that the gray hair had given place to black. Examination showed that his hair towards the ends had been white, and that nearer to the skin black. The white portion had been removed by the cutting. This phenomenon may frequently be noticed, attention having once been called to it.

The cases here collected are only a few in comparison to what might be found, but they are sufficient to prove beyond all reasonable doubt that the hair does suddenly change color under certain circumstances, and that the change takes place in existing hairs.

Analogous to changes in the color of the hair in man are the changes which occur in the lower animals. In animals and birds such changes are often periodical, as in their summer and winter coats. This occurs to a very marked degree in a great many species. Thus, the ermine in summer is dark brown, in winter pure white, with only the black tip to the tail.

Among birds, the ptarmigan is white in winter and brown in summer. So with our familiar bobolink: yellow in fall, in spring black and buff.

As to the question whether, in birds and animals, this change takes place in individual feathers and hairs, or whether all the old plumage and fur is shed by moulting, recent investigations favor the view that it is due to both. Dr. Elliott Coues ("Fur-Bearing Animals") says it may be either or both. Mr. Robert Ridgeway (Smithsonian Institution) inclines to the opinion that in birds it is accomplished by moulting.

Dr. Louis Stejneger (Smithsonian Institution) was formerly of the same opinion, but recent studies have inclined him to the belief that there is also a change in the color of existing feathers. He was led to this change of belief by a critical study of the changes in color of the black and white fly-catcher of Europe, and especially from an examination of a series of twenty-seven specimens of the narcissus fly-catcher (*Xanthophygalia narcissina*) of Japan. His studies in full appear in the "Proceedings of the United States National Museum, 1889." Dr. C. Hart Merriam, Ornithologist of the Agricultural Department, in a letter dated June 12, 1889, says, "The change from fall to spring plumage in birds is due to moult, without exception, as far as I am aware. In the case of mammals the matter is now in dispute. Probably in the majority of cases it is due in part to moult and in part to actual change in the color of existing hairs. . . . The change in color from immaturity to maturity is always due to the growth of new hairs or feathers."

That the change in birds and mammals is due, in part at least, to change of existing coats seems established. Sometimes this change is almost sudden, as where the change of season is very abrupt. In such case, of course, there would not be time for the growth of new hair or plumage.

In the golden plover (*Charadrius dominicus*), the black belly of summer changes to white in winter. While this change is taking place, individual feathers, part black and part white, may be seen.

In Bonaparte's gull, a common gull of our coast (*Larus Philadelphia*), the black of the head of summer changes to white in winter, principally by change in color of existing feathers (Ridgway).

Another interesting feature of this question,

* Professor Robert Ridgway, Smithsonian Institution.

as bearing on the change in the color of the hair by drugs, is the influence of certain substances administered as food, in changing the color of tissues in some of the lower orders.

In orange canaries it has come to be an established fact that, by feeding the parent birds with a certain kind of food, the active ingredient of which is cayenne pepper, the offspring will be of an orange color, and orange-colored canaries may be seen in the stores of most bird-fanciers. A food for producing orange canaries is extensively advertised by a bird-dealer in Baltimore (Bishop). It is reported that the Indians of the Amazon cause green parrots to change to yellow and red by feeding them upon the fat of a certain fish allied to the shad (Wallace's "Amazon").

Dr. Merriam, in the letter previously quoted, says, "It is well known that food affects the color in birds. Red purple finches and pine grosbeaks invariably turn yellow when caged. This is due undoubtedly to the absence of some important food element.

"In some of the zoological gardens of Europe it is the custom to send roseate spoonbills and flamingoes to Amsterdam Garden to be recolored. The particular food by which Mr. Westermann accomplishes this end is a secret, but it is believed to be a kind of shrimp or small crustacean which has a quantity of red pigment in its shell."

In the same direction are the changes of color in other tissues by particular foods. It has long been known that when pigs are fed on madder, their bones become red. This fact has been taken advantage of by physiologists in studying the structure and development of bone. The phosphate of lime acts on the coloring-matter of madder as a mordant. When given intermittently to a growing animal, the bone presents alternate rings of red and white.

Darwin ("Origin of Species") mentions that pigs in Virginia eat the paint-root (*Lachnanthes tinctoria*) and their bones are colored pink, and it causes the hoofs of all but the black varieties to drop off. "From facts collected by Heusinger it appears that white sheep and pigs are injured by certain plants, while dark-colored individuals escaped. . . . On asking some farmers in Virginia how it was that all their pigs were black, he was informed that the black members of a litter were selected for raising, as they only had a chance of living." Any one travelling through Virginia can verify this statement by noticing the preponderance of black pigs in that State.

Fleurens (1824) made use of madder for coloring the semicircular canals of pigeons, to outline the canals more distinctly. (See, also, Ferrier on "Functions of the Brain," and the writings of Vulpin, the French physiologist.)

Mr. Lucas, osteologist of the National Museum, informs me that the bones of the crow are made purple by feeding on pokeberries. Ridgway says the bones of the Western fox squirrel are red, while those of its Eastern brother are white. No cause has been assigned for the difference.

See, also, experiments by Marci Paolini in 1141. ("Specimen quorundam experimentorum de vi Rubiæ ad ossa ovorumque Gallinarium putamina calcariæ coloranda." No. 1 of "Miscellani Medichi," pamphlet vol. 1149.) He gives a very good plate of the colored skeleton of a fowl, and also of its colored egg after four months' feeding *Rubia tinctorium*. He also gives references to other authorities, the most satisfactory of which is Belchior ("Philosophical Transactions," vol. ix., 1732), who gives an account of feeding hogs and fowls with madder-root and wheat-meal. A rooster so fed died in sixteen days, and showed the condition admirably. Other writers take up the subject after him in the same publication.

It is reported that among workers in cobalt and indigo the hair becomes blue; also in artisans working with copper the hair takes a greenish hue.

The color of butterflies can be changed according to the food upon which the caterpillars are fed. More remarkable still, perhaps, is the change of color in the chameleon and in many insects, according to the color of the substance with which they are in contact.

The environment undoubtedly has a powerful influence upon the coloring of animals and birds. This is clearly illustrated in every museum of natural history. Specimens from arid desert regions are uniformly of a dull, faded appearance compared with those from regions of luxuriant foliage.

M. G. Pouchet ("Transactions of British Association for the Advancement of Science," 1872, p. 152), in his work entitled "Mechanism of Change of Color in Fishes," says that it is due to the size of contractile color-cells placed in the skin. These are under the influence of the nerves. The author found that the particular nerves controlling them (in the turbot) were nerves of the sympathetic system. By cutting the nerve supplying a particular area of the skin he had been able to retain that area unchanged in color, while the rest changed as the fish found itself on a dark or light surface.

That the eye is the means by which this change in its condition is communicated to the fish or crustacean, and that reflex action then takes place through the sympathetic nerves on the color-cells of the chromatophors, is proved by the fact that when the animal experimented on is blinded, no further change of color occurs when it is removed from light to dark, or the opposite.

See, also, the *Monthly Microscopical Journal*, 1871, vol. vi., M. G. Pouchet, on "Study of Connection of Nerves and Chromoblasts" (principally in fishes and batrachians).

The reasons assigned by naturalists for periodical change in color of plumage or fur are twofold:

1. Sexual selection.
2. As a protection against enemies.

1. Sexual Selection.—The male takes on a brighter and more attractive appearance to facilitate the business of courtship and the securing of a mate.

2. As a Protection against Enemies.—In Arctic regions birds and mammals are usually white in winter, the color of the snow, so that they are with more difficulty found by their enemies.

Darwin supposes that originally only a few individuals took on this change, and these being better protected, gradually, by a process of natural selection, only the white variety was left.

It is apparent from what has been said that there is very much concerning the changes of color of the hair and other appendages of the skin in man and the lower animals that is not understood. In its normal condition the color of the hair is dependent upon the hair-bulb.

It is here that the melanine is secreted from the coloring-matter of the blood, and from this point, as the hair grows, it permeates its cells, the intensity and shades, from black to blonde, depending principally upon the amount of the coloring-matter.

In black hair the hair-bulb is larger, contains a greater amount of melanine, and the hair itself is coarser and of more vigorous growth. In those cases where the hair has turned from white to black, and minute examination has been made, this has been found true.

In the case reported by Bruley, already referred to, of a woman, aged sixty, whose hair, previously white, became jet black four days before her death, the bulbs of the black hairs are described as being of immense size and engorged with dark pigment, while the roots of the white hairs that remained were dried up and two-thirds smaller in size.

So, on the other hand, in change from dark to white, the hair is finer in texture, less vigorous in growth, and the hair-bulbs smaller.

The sudden change in canities, when due to violent emotions, can be explained in no other way than through the bulb. It is true that there is no direct vascular or nerve connection between the bulb and its hair after it emerges from the skin; but it is also undoubtedly true that there is communication by osmosis between the cells of the papilla and those of the shaft and different layers of the hair.

Wilson ("Lecture on the Skin") ascribes the cause of sudden whitening of hair to insufficient nutritive power of the skin; also suggests that there may generate a gaseous fluid in the hair in place of its normal constituents.

He says, further, that the fluids from the blood-vessels of the skin permeate the hair, and thus change in fluids may alter color.

In all of the cases of sudden change to white, where the hair has been examined, the coloring-matter has disappeared, and in its place is found an accumulation of minute air-globules.

The same is true of gray hair of advancing age. How the air gets into the capillary structure has never been explained. Two possible explanations are offered:

One is that in the destruction of the coloring-matter a gaseous substance may be developed. This hypothesis has received no support from observation. The other is that air finds entrance from without through the sides or end of the hair.

It is possible to suppose a condition of the bulb producing a vacuum in the hair-shaft that shall cause, by suction, a drawing in of air. This theory, which is proposed for the first time by the writer, I believe to be the true one, as explaining not only sudden canities, but also the gradual senile change to gray hair.

The view that the air finds entrance through the end of the hair is supported by the fact that the change of color begins at the extremity, and also by the observation that in all cases of change to white from dark hair the coloring-matter has been found to be replaced by air-vesicles.

The *erector pili* muscle has an important influence on pathological changes which take place in the hair-bulb.

This minute muscle has its origin in the true skin, and, passing downward, is inserted into the base of the hair-bulb, so that when it contracts it lifts the hair outward and compresses its papilla.

The effect of sudden fright causes the hair to "stand on end" by contracting this muscle.

Temperature has its influence with animals and birds. In cold weather (winter) the change is to white, in summer to black.

Cold, we know, contracts the skin, and thus probably causes pressure on the hair-bulb. That the hair is easily influenced by external causes, as well as those which come through its bulb, is fully demonstrated. The mere fact that it can be so readily dyed and bleached artificially shows that the agents used for this purpose penetrate its substance.

Bleaching agents, such as chlorine, peroxide of hydrogen, and strong alkalies, act by removing the coloring-matter and not by adding any *whiteness* of their own.

It remains to say a few words upon the subject of changing the color of the hair by substances taken internally, and as this paper has already exceeded the limit I had set for it, I shall be brief.

1. In the human subject the only agent, so far as I am aware, which has been charged with changing the color of the hair, when taken internally, is jaborandi. Of this sufficient has already been said.

2. Cayenne pepper in changing the color of canary-birds to orange.

This is a well-known fact to bird-fanciers. I tried in Washington to get a specimen to show you, but was told it was not the season for them,—that they came in the autumn; also that they soon relapsed to their original color unless the Cayenne pepper food was kept up.

3. The change of color in parrots by the Indians of the Amazon, from green to yellow or red, by feeding the fat of a certain kind of fish (Wallace's "Amazon").

4. The restoration of certain birds to their original brilliant colors at the zoological garden, Amsterdam, by feeding a kind of shrimp or small crustacean.

5. As analogous to the above, the effect of madder in staining the bones of pigs red and of pokeberries coloring crows' bones purple.

It might be of interest, did time admit, to study the influence of diet and habit upon the color of hair in different nations of men, as, for instance, why the Saxons have light hair and the Gauls black hair.

It is within the bounds of possibility also that discoveries may be made in the future by which the color of the hair in the human race may be modified by judicious treatment of the parents.

Some colors of hair are not popular, especially with ladies, and it is not likely that Cayenne pepper will ever become a favorite to produce the orange hue.

HYDROGEN DIOXIDE AS AN AID IN THE DIAGNOSIS OF SINUSES, FISTULA, CONCEALED PUS-CAVITIES, ETC.

By W. M. L. Coplin, M.D.,
Adjunct Professor of Hygiene, Demonstrator of Pathology, and Curator of the Museum, Jefferson Medical College; Surgeon to St. Mary's Hospital; Adjunct Professor of Pathology, Philadelphia Polyclinic; Pathologist to the Philadelphia Hospital.

IN washing out a cavity in the bone, near the upper end of the tibia, I was extremely desirous of knowing its extent and whether it communicated with any adjoining cavity. That gas is liberated from hydrogen dioxide coming in contact with necrotic tissue, either suppurative in character or otherwise, is well known. If the hydrogen dioxide be injected into a cavity which communicates directly or indirectly through a sinuous canal, the second cavity will become inflated by the involved gas set free in the first cavity, and if we then apply the ordinary test for the detection of gas in a cavity (percussion, auscultation, palpation), we may readily prove the communication of the one cavity with the other. This is very often desirable in securing drainage, and more especially in articular and periarticular suppurative processes. Thus, in the case already cited, an abscess had presented itself over the external aspect of the head of the tibia, where it had been opened; the abscess cavity communicated with a similar cavity in the head of the tibia. Both cavities were freely curetted. So far as known, neither cavity communicated with any other, and there was no external evidence of perforation of the cartilaginous disk, between the epiphysis and the shaft, at any other point than the one located immediately under the subcutaneous abscess-cavity. By injecting hydrogen dioxide, however, it was discovered that at several points the gas inflated the subcutaneous tissues, as shown by the crepitation and gaseous emphysema which were discernible around the joint after the injection of the hydrogen dioxide; further, and most important of all, the joint was shown not to be connected with the abscess, as no gas entered between the articular surfaces. I was impressed with the applicability of this method, and I believe that in tracing out sinuses, and possibly in gunshot wounds, stabs, etc., one might be able to utilize the dioxide as a test. Hydrogen dioxide being a powerful disinfectant, combines this most excellent quality with other features desired. It seems probable that vesical, utero-vesical, vesico-vaginal, and allied fistulous communications might be, in one sense, explored by this method. I have had occasion to use it once

in the study of mastoid abscess, in which communication between the auditory canal and the abscess-cavity was proved by injecting hydrogen dioxide into the ear and at the same time noting the gaseous distention of the tissues over the mastoid. That it might be possible to force infectious material into non-infected tissues by this method of exploration seems not improbable, but an incision, probe, or any other method affords equally tenable objections, and but few, if any, other methods combine the use of an efficient germicide with the means employed, as does this. Moreover, wherever the gas did penetrate, the knife would follow for evacuation and thorough disinfection.

RULES FOR THE NURSING OF OBSTETRICAL CASES AS PRACTISED IN THE MATERNITY DEPARTMENT OF THE HOSPITAL OF THE UNIVERSITY OF PENNSYLVANIA.

COMPILED BY FRANCIS LIEBER, M.D.,
Resident Physician.

TOO much care cannot be taken of women during the period of gestation prior to confinement, since their welfare depends as much upon careful nursing at this time as does their good recovery upon systematic and thorough treatment during delivery and the puerperium.

Any pain having the character of a labor-pain—well known by multiparæ, and easily recognized by primiparæ as beginning generally in the back, passing forward, or at the umbilicus, returning at regular intervals—should be reported at once. Delay in obstetrical work is often dangerous.

Preparation.—Should the woman be found in labor, she should be given a bath; her bowels should be evacuated by an enema, urine voided, and clean clothing throughout given.

The bed upon which the patient is to be delivered should now be made ready. The mattress is protected by a full-length mackintosh; over this a sheet; then another full-length mackintosh and a second sheet. Upon this sheet place a half-mackintosh, in the middle of the bed, covered by the delivery-pad.

The delivery-pad can be made of sterilized cheese-cloth, filled with bichloride jute, or several layers of disinfected flannels and blankets, about one yard square.

The patient is now put to bed, and preparation made for the delivery and reception of the child.

For General Use.—Two empty basins; douche-jar and support, the douche consisting of creolin (two-per-cent. solution), made by adding five fluidrachms of creolin to two pints of water; one pitcher of cold water; vinegar; bichloride, 1 to 2000, in small basin; carbolic, 1 to 20, in instrument-pan; absorbent cotton; six towels; one can of ether and ether-cone; whiskey; hypodermic syringe; two medicine-glasses; fluid extract of ergot; cosmoline; soft-rubber catheter; silver catheter; forceps, placed blade down in an empty pitcher (if the forceps are to be used, boiling water is to be poured over them, allowing them to remain in the pitcher); obstetrical instruments; ice and hot water should be easily accessible.

For the Mother.—Two sheets, draw-sheet, blanket, night-dress, binder, three dressing-towels, an occlusive pad, napkin, and safety-pins.

For the Child.—Baby-tub, large basin, covered hot-water bag, flannel receiver, two cotton receivers; nitrate-of-silver solution, ten grains to one fluidounce; boric-acid solution, fifteen grains to one fluidounce; dropper belonging to each solution, mouth-rags in boric-acid solution; iodoformized bobbin or antiseptic silk, in two strips, each ten inches long (prepared by soaking in ether, one fluidounce; pulverized iodoform, two drachms, for six hours); scissors in carbolic solution, 1 to 20; sweet oil.

In Case of Laceration.—Rubber perineal-pad, dressing-towels; instruments in carbolic solution (1 to 20), dressing-forceps, small scissors, needle-holder, needles, large and small; in alcohol, catgut, silk-worm gut; bichloride sponges and bichloride solution (1 to 2000); iodoform powder.

Nursing during Delivery.—The nurse should now wash her hands, first in soap and water, then in alcohol, then in bichloride solution (1 to 2000), in which they should be kept for at least one minute. (This cleansing should be observed throughout the case, and practised when the patient is to be catheterized or to have her breasts treated, etc.) The nurse is then ready to assist during the delivery.

When the patient is put to bed, at no time should she be left without an attendant. The frequency and strength of the pains should be noted, and the rupture of the membranes reported and the time taken.

As soon as the head is born, the baby's eyes should be washed with the boracic-acid solution, and a drop of the nitrate-of-silver solution placed in each eye; fluid extract of ergot, 1 fluidrachm, with a little water, should

be given to the mother, and the flannel and cotton receivers for the child, the braid for tying the cord, and the scissors be got ready for immediate use.

As soon as the child is born, a basin is brought to the bed for the reception of the placenta.

When the cord is cut, the baby—well oiled with sweet oil and wrapped in the receiving cloths—is laid aside until the mother is attended to. A covered hot-water bag can, with advantage, be placed near the baby to avoid chilling caused by the change in its surroundings.

Nursing during the Puerperium.—After the placenta has been expelled, the mother's bed should be remade, the binder put on over a compress of towels above the uterus, and an occlusive pad and napkin fastened to the binder.

The patient must lie on her back for three days, and without a pillow for the first six hours. She may be moved from side to side on the bed and rubbed with alcohol daily.

If, after twelve hours, she is unable to void urine, she must be catheterized. Cleanse the meatus with bichloride solution, 1 to 4000. If necessary, catheterize at least once every eight hours.

The occlusive pad should be changed about six times in twenty-four hours for the first three days, and subsequently as frequently as needful. At each change the parts are to be thoroughly washed with bichloride solution, 1 to 4000. The last pad taken off should be saved for the doctor's inspection.

The temperature for the first five days should be taken every four hours, and then twice daily unless other orders are given.

The Patient's Diet.—First forty-eight hours: liquid, with a little toast and butter. Second forty-eight hours: toast, eggs, chicken, and puddings.

After the bowels have been moved, the diet may be more liberal, gradually returning to a full diet.

The Child.—After being well oiled with sweet oil, the baby is to be washed with Castile soap and water; the temperature of the water should be about 90° F. The cord is dressed by dusting it with a powder of salicylic acid one part and starch five parts, placing around it some salicylated cotton cut for the purpose. Watch carefully for bleeding.

The baby should now be dressed by putting on a flannel binder twice around the abdomen; this binder had better be sewed on; a diaper, flannel shirt, knit shoes, one skirt of flannel, and, finally, a slip and knit sack. Wrap it in a baby blanket and put it in the crib, allowing it to lie first on one side and then on the other.

The baby should receive a daily bath in the warmest part of the room, the water having a temperature of 90° F. Use Castile soap, and in washing avoid the eyes. Dress the cord after each bath as directed. Powder the baby with a powder of lycopodium, compound talcum, or lycopodium and oxide of zinc, and dress as before. The cord is shed about the third or fourth day, and when shed, the stump should be dressed for a day or two with the diluted salicylic-acid or boracic-acid powder.

Feeding.—The baby should be put to the breast once every four hours for the first forty-eight hours, then once every two hours during the day from 7 A.M. to 9 P.M., and from two to three times at night, no other food being given it.

After every nursing the nipples must be carefully washed with warm water and Castile soap, and oiled with a little sweet oil.

The Massage of the Breasts.—The true milk secretion may be expected about the third day. Should it be noticed then or at any time that the breasts are hard and unrelieved by the baby's nursing, they should be given systematic massage and pumping. The nurse must first cleanse her hands thoroughly and wash them in bichloride solution, 1 to 2000; then oil them with a little sweet oil to avoid irritating the skin over the breasts, and, by a gently stroking motion directed from the base to the nipple, relieve the breasts of milk and soften the so-called "cakes." The breast-pump should also be used, if necessary, and with it several ounces of milk drawn from each breast. After this process, which should be carried out as often as necessary, the breasts must be washed with Castile soap and water, oiled, and covered by a cloth and mammary binder. This binder consists of a double piece of muslin, cut so as to allow straps to come over the patient's shoulders. It is pinned with safety-pins in the median line in front, starting at the point nearest to the patient's waist, so as to provide support as well as evenly-distributed pressure (Miss Murphy's binder). A pledget of absorbent cotton is placed between the breasts to prevent the skin surfaces rubbing on one another.

By the care to secure perfect cleanliness about the patients on the part of nurses and medical attendants the mortality of the hospital has been kept *nil* for four years.

OPEN INCISION TENOTOMY, WITH REPORT OF A CASE IN WHICH THE TENDON WAS SUTURED BY THE ANDERSON METHOD.

By James F. E. Colgan, A.M., M.D.,
Chief Clinical Assistant Orthopædic Department, Jefferson Medical College Hospital; Chief of Dispensary of St. Mary's Hospital.

BOTH Galen and Hippocrates advised against the suturing of tendons, and so dominating have been the views of these great pioneers in medicine that their teaching has persisted till comparatively modern times, Ambroise Paré, for instance, fully according with them.

In traumatic cases tendons were sutured more than two centuries ago. Operations upon these fibrous bands for orthopædic purposes were proposed and carried out much later.

The first recorded operation of tenotomy was done by the open method, though suturing was not performed. In this relation the following quotation is interesting ("Herster's Surgery," Part II., page 333; London, 1777):

"It is observable that this practice (suturing of tendons) has lain neglected by almost all the ancients, in comformity to the saying of Hippocrates, 'that a nerve or tendon, being cut asunder, can never grow nor unite afterwards,' which gave them an aversion to this operation, inasmuch as a slight puncture in a tendon often excites the most grievous symptoms. Yet that there were some in the time of Galen who practised this suture of the tendons may be concluded from his advising against it, and which advice was rigidly adhered to by the generality, and especially Ambroise Paré. However, this has been sufficiently considered and approved of by the Arabian physician Avicenna, Guido de Cailico, Sulicetus, Rogerius, Lafrancus, Brunus, and others among the surgeons; and yet, notwithstanding this, the practice was either unknown or rejected as dangerous by their successors till at length Vestingius performed it in the last century. This operation succeeds best when the wound is recent or lately inflicted, but it may be also undertaken on the second, third, or fourth day.

"The first operation of tenotomy is ascribed to Roonhuysen, of Amsterdam, who divided the sterno-mastoid in 1670. All the earlier operations were carried out by the open method. The tendon was exposed by reflecting the skin, and was then divided.

"Later, we find that a knife was introduced beneath such a tendon, as the tendo Achillis, and that structure was divided simultaneously with the skin" (vol. i. 753).

The great discovery of subcutaneous tenotomy was, however, reserved for the genius of L. Stromeyer, of Hanover, who first performed the operation in February, 1831, and published his first six cases in 1834.

Dr. David L. Rogers, of New York, first performed tenotomy in this country. "He divided the tendo Achillis in 1834" (Sayre, page 4).

It is sufficiently clear on reading the history of tenotomy that the open method was first practised universally; this then gave place to the subcutaneous incision. At the present day the open method is again coming into favor.

The advantages of the subcutaneous method are, that it requires a very small puncture. There is comparatively no hemorrhage unless a large vessel is divided, when the operation must be abandoned till collateral circulation is set up. There is no suppuration if the instruments are clean.

The disadvantages of the subcutaneous method are, that when you cut tissues under the skin, there is always a possibility of wounding structures you wish to avoid. Before the advent of antisepsis it was justifiable to perform the subcutaneous operation, because suppuration was usually avoided, but to-day this objection does not hold.

The great field for suturing tendons for correction of deformity is afforded by those cases suffering from talipes equinus. This is especially so when the deformity is due to infantile paralysis.

After tenotomy, the new tissue uniting the divided ends of the tendon is not actually tendinous tissue. It is true that in the majority of cases it will act fully as well as tendon, but in a large structure like the tendo Achillis there is always a possibility of the union being imperfect. R. W. Parker acknowledges that several authors express the same opinion, though he says it never occurred in his practice. In deformity due to infantile paralysis, there is always a likelihood of the new tissue becoming so attenuated as eventually to snap asunder, especially when the gap is large. That this is likely to occur is proved by the fact that within a few months a child was brought to the Jefferson Medical College Hospital for treatment of club-foot. The child had been operated on by an eminent surgeon for relief of deformity caused by talipes equinus, the subcutaneous method being employed. When the child appeared at the hospital the deformity was of the calcanean form, due to the elongation of the tissue thrown out between the divided ends of the tendon. Professor H. Augustus Wilson decided to attempt to shorten the tendon and suture it at a correct point. An incision being made, the tendon was found to be

so attenuated that there was hardly sufficient space to introduce the finest needle in order to suture the ends together. Consequently the prognosis as to function was guarded.

This suturing operation is particularly adapted to equinus occurring in adults, since the gap between the divided ends is naturally larger and the tendon is more powerful than in children.

In the operation by which the tendon is slit longitudinally and sutured after it has been divided, we have a method overcoming the disadvantages inherent to the ordinary tenotomy. The tendon is practically composed of the same tissue throughout its length.

The first operator to report a case of deformity corrected by the operation of slitting a tendon and then suturing the end was Professor W. W. Keen, of Philadelphia. The operation had been done at the suggestion of Dr. S. Weir Mitchell. The same method had been employed over a year before by William Anderson, of England, but was not made public till some time after Professor Keen's case had been reported. In the operation as performed by Anderson and Keen the tendon is slit longitudinally for the distance of an inch or two, then divided at the opposite ends of the incision. The part is put in the corrected position, and the divided ends are sutured. By this method we have the tendon lengthened by a definite amount. Both Anderson and Keen use this method for contracted tendons, while Professor H. Augustus Wilson proposes the same method for shortening elongated tendons.

In the *Centralblatt für Chirurgie*, No. 12, Dr. Truka reports a method of suturing tendons that he has employed for some time. In this operation part of the tendon is turned down and is sutured to the other end of the divided tendon, the sutures being also carried through the other sides of the ends. This, though an ingenious method, is inferior to the Anderson method.

Several operations by the Anderson method have been performed at the Jefferson Medical College Hospital. The report of one of these is as follows:

Miss L. S., aged seventeen, came to the Jefferson Medical College Hospital October 20, 1892. There was phthisis in the family.

The trouble first commenced when the patient was three years old. On one side of the foot at the ankle-joint there was an enlargement; pain and stiffness were present also. The enlargement was succeeded by a fluctuating tumor which, opening itself when she was eight years old, proved to be an abscess. From the history it cannot be ascertained whether the abscess communicated with diseased bone or not, nor is it known how long the sinus remained open. After the opening healed she was forced to use crutches. She then began to walk on her toes. From the age of eight years she used constitutional and local treatment, consulting several physicians in the mean time.

When she appeared at the hospital the tendo Achillis was found to be contracted, and there was an improper motion of the ankle-joint; on over-extension the foot became swollen. There was, of course, marked equinus, due to the contracted tendo Achillis.

As will be observed from the history, the deformity was acquired. The patient had an abscess, which no doubt communicated with the bone, which forced her to keep the foot in a comfortable position. As she suffered great inconvenience from the deformity, operative interference was desired.

The field of the operation being rendered aseptic, forced flexion of the foot was made for the purpose of rendering the tendon prominent. The tendon was then freed, and an incision of an inch and a half in length was made longitudinally through its middle. Cross-sections were made at ends of the incision diagonally opposite each other, thus dividing the tendon. The divided tendon was then lengthened by sliding the divided ends past each other till the foot was placed in the correct position; then the tendon was united with catgut sutures. There being no vessels in that place to wound, drainage was not necessary, and the skin was brought together with sutures. A plaster-of-Paris dressing was applied to keep the foot in the corrected position, after which the patient was placed in bed, where she remained for one week.

On November 10 the plaster-of-Paris dressing was removed, when the tendon was found to be united. The gaps were filled with the new fibrous tissue thrown out. The plaster of Paris was discarded, and she was directed to use a crutch for a short time.

On November 17 she was discharged from the hospital. The crutch was thrown aside December 13, and she was provided with a brace, which was applied inside the shoe, to prevent any future trouble in the previously inflamed joint.

The patient reported off and on at the hospital till June 1, 1893, when she left for her home in Utah Territory. The os calcis and astragalus were rigid, but there was increased motion in the ankle-joint, and she walked with

very great ease, the only inconvenience being a little pain now and then in the ankle-joint, due, no doubt, to the original trouble.

1110 FRANKFORD AVENUE.

A STUDY OF THE INFLUENCE OF CHLOROFORM UPON THE RESPIRATION AND CIRCULATION.

A CONTRIBUTION FROM THE LABORATORY OF EXPERIMENTAL THERAPEUTICS OF THE JEFFERSON MEDICAL COLLEGE OF PHILADELPHIA.

BEING A REPORT TO SURGEON LIEUTENANT-COLONEL EDWARD LAWRIE AND TO THE GOVERNMENT OF HIS HIGHNESS THE NIZAM OF HYDERABAD.

BY H. A. HARE, M.D.,
Professor of Therapeutics in the Jefferson Medical College,
AND
E. Q. THORNTON, M.D.,
Demonstrator of Therapeutics, Jefferson Medical College.

TO any one who endeavors to view the subject of chloroform anæsthesia in an entirely impartial light two objects raise themselves so high above all others that they form the peaks about which the smaller questions must cluster. The first object on which the judicial eye rests is the firm belief of many clinicians that chloroform may cause sudden cardiac death; the second object to be seen is the statement of the Hyderabad Chloroform Commission that death from chloroform is never due to cardiac failure. In the support of the first belief we have not only wide clinical observation, but also the experimental evidences of a number of investigators. In support of the second statement we have an array of experimental study not equalled by any other research extant, associated with an enormous number of negative observations on man. Negative observations because Lawrie alone in twenty-five thousand cases has never had a cardiac death.

The controversy concerning the action of chloroform upon the animal organism has been waged so incessantly for many years, and has led to such extraordinary efforts for its elucidation and final decision, that any one who attempts to take part finds himself almost swamped by the number of statements and opinions which he is forced to regard. We have therefore approached this research feeling it was no ordinary task, and that a path already so well travelled must be gone over with the utmost care if anything new or of value was to be discovered.

In March, 1892, Surgeon Lieutenant-Colonel Lawrie, whose interest in this subject is recognized by the medical profession the world over, wrote to one of us (Hare), asking that another chloroform research be instituted, for which the government of His Highness the Nizam of Hyderabad would pay. The express object of the research was the reconciliation of at least some of the contradictory conclusions reached by various experimenters during the past few years.

From the immense number of observations, in regard to the action of chloroform, in the laboratory and in the operating-room it is evident that sufficient data are at hand to give us material to reach positive conclusions, and that the contradictory results hitherto obtained must have been reached by misinterpretation and error in experimental method, tinctured perhaps by opinions formed previous to the completion of a line of study. There are certain facts in regard to chloroform which few will deny, the chief of which are that it has the advantage of rapid action without disagreeable preliminary or subsequent symptoms, its bulk is small, and its odor agreeable; but, more important than all, it is much more dangerous than ether.

Though the Hyderabad Commission in their preliminary conclusions (page 30, paragraph 43) assert that ether is as dangerous as chloroform if given sufficiently to produce true anæsthesia, we believe that the safety of ether is so universally recognized that this conclusion of the Commission can only be excused by the remembrance that ether has probably been used as little by those who wrote this paragraph as chloroform is used in many parts of America. This possibility is made a probability when we read that "if surgeons choose to be content with a condition of semi-anæsthesia, it can no doubt be produced with perfect safety, though with discomfort to the patient, by ether held rather closely over the mouth. Such a condition of imperfect anæsthesia would never be accepted by any surgeon accustomed to operate under chloroform." That this statement shows, to put it mildly, that the writer knows not whereof he speaks is proved by the universal employment of ether by hundreds of the best surgeons the world over in preference to chloroform. Further than this, medical literature contains so many statistical papers showing the small percentage of deaths from ether as compared with chloroform that this point need not be debated.

There are certain other points in regard to the action of chloroform which may be put aside as settled, and therefore not needing further study, being generally received as beyond criticism, and we have made no experiments

looking to their reproduction, but have devoted our efforts solely to the questions over which discussion still proceeds. Thus, all investigators concur in the statement that chloroform, even in ordinary therapeutic quantity, acts as a powerful and constant depressant to arterial pressure. This conclusion has been reached by Bowditch and Minot and Coats, H. C. Wood and H. A. Hare, Gaskell and Shore, the Hyderabad Chloroform Commission Nos. 1 and 2, and by every experiment in the research now carried out which forms this report. There is no evidence to the contrary, and practically it has never been denied. Gaskell and Shore state, however, that chloroform may cause anæsthesia without lowering blood-pressure, and that chloroform causes primarily a rise of pressure. They also believe that the chief cause of the fall of arterial pressure is cardiac and not vaso-motor depression. The rise we have never seen except from struggles, and we have never been able to produce anæsthesia without lowering the blood-pressure, even when the drug was used in the smallest quantity capable of causing anæsthesia and given as slowly as possible. We agree with the statement of the Hyderabad Commission that a fall of blood-pressure always occurs when chloroform anæsthesia is produced.

We are also forced, as the result of our studies, to differ entirely with Gaskell and Shore in their statement that the fall of arterial pressure is due primarily to a weakening of the heart's action and not to paralysis (depression ?) of the vaso-motor centre. We believe that both factors cause the fall, but that the dominant factor is vaso-motor depression, because, as will be seen in several of our tracings, the pulse-waves were quite strong, though the blood-pressure, through vaso-motor relaxation, was absolutely to the abscissa line, and we agree with Lawrie that no conclusions as to the action of chloroform when inhaled can be drawn from the injection experiments of Gaskell and Shore into the arteries. One of our reasons for this belief is the entire difference in method necessary and the corresponding difference in result. Another reason is that any powerful drug injected into the brain will cause a rise of blood-pressure. Even nitrite of amyl, the prince of vaso-motor paralyzants, will do this. (See Gaskell and Shore, page 17, paragraph 68.)

We also believe that results obtained by such interesting methods of experimentation as employed by Gaskell and Shore are not capable of giving us positively reliable information, as the conditions are so utterly at variance with those in which chloroform is given to man; and, further, that their methods are such as to give room for fallacious results, which cannot be excluded by the greatest caution on the part of experimenters, experienced as they are.

Secondly, it is not denied by any one, that we know of, that chloroform exerts a powerful depressant, paralyzant action on the respiratory centre. This is agreed to by clinicians and by every one who has experimentally studied the action of the drug on the lower animals. (See results of collective investigation.)

Thirdly, it is universally conceded that chloroform is a lethal agent of great power when brought in direct contact with highly-vitalized tissues.

Aside from these facts, there are a number of others in which we find ourselves strictly in accord with the conclusions of the Hyderabad Commission. In order to make clear those points in which we agree and differ, we print the conclusions reached by the Commission, and to be found on page 17 of their official report.*

"1. Chloroform, when given continuously by any means which insures its free dilution with air, causes a gradual fall in the mean blood-pressure, provided the animal's respiration is not impeded in any way, and it continues to breathe quietly, without struggling or involuntary holding of the breath, as almost always happens when the chloroform is sufficiently diluted. [See our Experiments 1, 4, 13, 23, and 27 (Hare and Thornton).]†

"As this fall continues the animal first becomes insensible, then the respiration gradually ceases, and, lastly, the heart stops beating. [In every one of our experiments this course was followed as soon as struggles ceased (Hare and Thornton).]

"If the chloroform is less diluted the fall is more rapid, but is always gradual, so long as other conditions are maintained; and however concentrated the chloroform may be, it never causes sudden death from stoppage of the heart. The greater the degree of dilution the less rapid is the fall, until a degree of dilution is reached which no longer appreciably lowers

* These are not the final conclusions, published in the *Lancet* and elsewhere, which were drawn up for general readers, but from the more scientific and accurate deductions of the research itself.

† It is unfortunate that space does not permit the reproduction of every experiment made, or even every part of the ones given. As far as possible every valuable part has been included.

the blood-pressure or produces anæsthesia." (See below.)

With this entire statement our results are practically in accord, but we would like to qualify the words "however concentrated the chloroform may be, it never causes sudden death from stoppage of the heart" by saying it never has caused sudden stoppage of the heart in any of our experiments unless respiration ceased primarily. We make this modification because, as we will point out later in this report, we believe circumstances may exist in which the diseased heart may stop suddenly under chloroform. On the other hand, we do not believe that it is possible in a lower animal (the dog) to cause cardiac death by the freest possible use of chloroform by inhalation without causing primary respiratory arrest, and respiratory arrest having taken place, the death which follows is partly due to asphyxia and partly to direct cardiac failure and vaso-motor paralysis.

In reaching this conclusion one of us (Hare) is well aware that his position is directly opposed to his conclusions published in a joint paper by H. C. Wood and himself in the *Medical News* of February 22, 1890. The tracings shown in that paper, to prove that chloroform was capable of causing primary arrest of the heart, are all (except No. 5) tracings of experiments in which chloroform was *injected directly into the jugular vein*, which is an entirely different thing from its absorption from the lungs into the blood well mixed with air. Even quinine injected into the jugular vein will cause cardiac arrest. Further than this, this research has shown us that in only one of the three tracings presented by Wood and Hare did death *certainly* occur from cardiac failure, even when the drug was given intravenously,—namely, in their tracing No. 4. Perhaps if artificial respiration had been resorted to recovery would have occurred, as our experiments have proved is possible even after both heart and respiration have apparently stopped. (See Nos. 3, 13, 17, and 27, Hare and Thornton). The pulse-line in Tracing No. 3 (Wood and Hare) is more than reproduced by jugular injection in No. 14 in this research, and No. 5 (Wood and Hare) by inhalation in No. 23 (Part XV. and XVI.) of this research, and it will be noted that though the heart failed in these experiments to make a pulse-mark, for the time being, that it eventually recovered sufficiently to do so or was found beating when the chest-wall was opened or a needle was thrust into the heart. Again, in Experiment 13, in this research (Hare and Thornton), it will be seen that when the pen was practically at the abscissa it suddenly rose again. The heart was in all these experiments very weak, but it recovered rapidly from its weakness, so we must conclude that the cardiac condition was one of weakness or depression and not paralysis or death.

"2. If the inhalation is interrupted at any stage, the fall of pressure still continues at a rate which depends altogether on the rapidity of the fall while the chloroform was being inhaled. This after-fall is probably due to absorption of a portion of the residue of chloroform in the air-passages after the stoppage of the inhalation. In this way it often happens, if chloroform is given rather freely, that though the respiration may be going on when the chloroform is discontinued, it afterwards stops. [Our results are identical with this conclusion.]

"3. If the administration of the chloroform is stopped at an early stage the pressure very soon begins to rise again, and gradually becomes normal. [See our Experiments 8, 13, 17, 23, and 27 (Hare and Thornton).] But if the chloroform is pushed further, there comes a time, not easy to define, when the blood-pressure and respiration will no longer be restored spontaneously, although the heart continues to beat after the inhalation is stopped. [See our Experiments 1, 5, 10, 13, 16, 17, 18, and 23, all of which confirm this conclusion (Hare and Thornton).]

"4. If the fall has been very gradual, it may occasionally happen that the respiration stops completely, and still the blood-pressure rises again, the respiration recommencing spontaneously in the course of the rise. [See our Experiments 12, 13, 17, and 26 (Hare and Thornton).] In the same way, when the inhalation has been discontinued, the respiration may stop during the after-fall of the blood-pressure and begin again spontaneously. As a rule, if the respiration has stopped, or even becomes slow and feeble at the time when the inhalation is discontinued and artificial respiration is not resorted to, the fall in blood-pressure will continue until death ensues. [See end of our Experiments 1, 5, 10, 13, 17, 18 (Hare and Thornton).]

"5. There are two conditions which frequently disturb the gradual fall of the blood-pressure,—viz., struggling and holding the breath,—and it is only by great care that they can be avoided in animals. [Our results are entirely in accord with this.]

"6. Struggling, independently of any change in the respiratory rhythm, appears generally to raise the blood-pressure. [See our Experiments 13, 15, 16, 27 (Hare and Thornton).]

In one case of a dog much weakened from phosphorus the pressure fell every time he struggled. [We agree with the first sentence, but believe that struggling and change in respiratory rhythm are inseparable. Of the facts in the second sentence we have no knowledge.]

"7. When struggling is accompanied, as it often is, by acceleration of the respiration and pulse, especially if the respiration is deep and gasping, it leads to a more rapid inhalation of chloroform, and consequently to a more rapid fall of blood-pressure and a greater after-fall. [Compare our Experiments (Hare and Thornton) 13, 16, and 27 with Experiment 23, in which there was no struggling and a gradual fall.] In order to keep the chloroform-cap or inhaler in its place during the animal's struggles, the administrator is obliged to hold it down more tightly over the nose and mouth, and this materially assists in hastening the rapidity of the inhalation, and consequently of the fall in blood-pressure. [We agree with this statement.]

"8. The effect of involuntarily holding the breath, which, as anybody can prove by experimenting upon himself, must happen when an inhaler saturated with chloroform is first applied to the face, is much more remarkable, the pressure often falling with great suddenness, while the heart's action is markedly slowed. [See Experiments 1 and 5 of Wood and Hare, No. 1 being reproduced in this paper.] As soon as the animal draws breath again the pressure rises as suddenly as it fell, but the gasping respiration which succeeds then causes very rapid inhalation of chloroform with immediate insensibility and a rapid fall of blood-pressure which becomes dangerous. [See our Experiment 13 (Parts IV., V., VI.), and Experiment 17. This fall is sometimes dangerous and sometimes not. Certainly not a dangerous fall in Tracing No. 16 under atropine. Taking the paragraph as a whole, we agree with its statements entirely, and believe that the first action named is solely due to reflex inhibition through vagal and trigeminal irritation (Hare and Thornton).]

"9. The combination of struggling with alternate holding the breath and gasping, which results if chloroform is applied closely to the face without sufficient dilution with air, causes violent fluctuations and then a speedy fall of the blood-pressure, which very soon leads to a dangerous depression with deep insensibility and early stoppage of the respiration. [See our Experiments 13 and 27 (Hare and Thornton).] The after-fall under these circumstances is rapid and prolonged (*sic*). [We also find it rapid.] It is this combination of events which causes struggling animals to go under chloroform so quickly.

"10. The effect of holding the breath may occasionally cause a temporary fall of blood-pressure after the chloroform inhalation has been stopped, or even when the animal is quite out of chloroform. This fall is recovered from directly the animal breathes again. [We concur in this.]

"11. Slight, continuous asphyxia, such as is produced by pressure on the neck by straps, a badly-fitting muzzle, or hinderance of the chest-movements by the legs being too tightly bound down, gives rise to exaggerated and irregular oscillations of the blood-pressure and slowing and irregularity of the heart's action. If it leads to, or is accompanied by, deep gasping inspiration, it is apt, like anything else which causes this, to increase the intake of chloroform and bring about a rapid decline of blood-pressure. [We concur in this conclusion.]

"12. Complete, or almost complete, asphyxia, as by forcibly closing the nose and mouth, or closing the tracheal tube after tracheotomy, has an effect similar to, but more marked than, that produced by holding the breath, and the character of the trace corresponds precisely to that produced by irritation of the peripheral end of the cut vagus. The pressure falls extremely rapidly, sometimes almost to zero, and the heart's action becomes excessively slow or even stops for a few seconds.

"13. This effect of asphyxia is the result of stimulation of the vagi. The proof of this is (*a*) that the trace corresponds exactly, as stated above, to that produced by direct irritation of the vagus; (*b*) division of both vagi entirely abolishes it; and (*c*) the administration of atropine, which paralyzes the vagus, also abolishes it. [Tracing No. 15 Part I. (Hare and Thornton). That vagal irritation does account for some of the circulatory disturbance is no doubt true, but in reality the changes are chiefly vasomotor in character. We have not found that either vagal section or vagal paralysis with atropine prevented these phenomena, although it may modify them. See Tracing Nos. 10 and 17 (Hare and Thornton).]

"14. In Trace 158 (Fick, No. 4), which was taken during asphyxia after a full dose of atropine, it will be seen that there is an alternately slow and rapid pulse, according to the phase of the respiratory movement, but no continued slowing of the heart, as in vagus irritation. But there was still a distinct fall of pressure after the atropine when the breath was held,

and it was thought that the slowing of the pulse above noted in this condition might be due to the disturbance of the heart from tension in the pulmonary vessels in the absence of respiratory movement rather than to irritation of the vagi. To test this point Experiment 184 was instituted. In this experiment the dog's chest was forcibly inflated with bellows connected by a tube with the trachea, and the effect of this proceeding was to cause a fall of pressure and slowing of the heart, exactly the same as in involuntary holding of the breath. The dog was then poisoned with atropine, after which inflation of the chest still caused a fall of pressure, but without slowing of the heart (*vide* Fick, Nos. 8 and 9). The fall of pressure must be in some degree independent of vagus irritation, which, however, usually accompanies it.

"15. It only remains to be considered whether the slow action or temporary stoppage of the heart, with great fall of pressure produced by vagus irritation, is in itself an element of danger in chloroform administration, and if it is not, wherein the danger actually lies. [See note to paragraph 16 (Hare and Thornton).]

"16. The experiments in which deliberate irritation of the vagi was carried on during anæsthesia show unmistakably that irritation of these nerves diminishes rather than enhances the danger of anæsthetics. The effect upon the heart is never continuous, and as the vagus becomes exhausted, or when the irritation is taken off, the blood-pressure rises again, as it does when the same result is produced by asphyxia. The slowing of the heart and circulation which is produced by irritation of the vagus by any cause, such as holding the breath in chloroform administration, retards the absorption and conveyance of chloroform to the nerve-centres, just as holding the breath, whether voluntary or involuntary, prevents chloroform from entering the lung; and of itself slowing or temporary stoppage of the heart in chloroform administration is not dangerous. [We shall point out later in this report how we differ from this conclusion, for we believe that true fatty heart, plus ventricular engorgement, plus vagal irritation, plus possible valvular disease, and, finally, plus extreme vaso-motor relaxation, may result in death in frightened persons. While this is not, scientifically speaking, a cardiac death from chloroform, practically the chloroform is the last straw which upsets the cardiac balance. However, Lawrie and his colleagues recognize this as well as ourselves (see paragraph 38, Hare and Thornton).]

"17. To answer the second part of the last question in paragraph 15 is easy enough, if it is kept in mind that the effect of vagus irritation upon the heart is never continuous; and in chloroform administration, as the pressure rises again after the slowing of the heart and temporary fall of pressure produced by any form of asphyxia, violent respiratory efforts with bounding heart's action lead, as in the case of struggling, to a rapid and dangerous inhalation of chloroform, and consequent rapid and dangerous decline in blood-pressure. [We believe in the *healthy* animal or man that this is true.] It is, in fact, the temporary exhaustion of the vagi after stimulation that is to be feared, and not the actual stimulation as long as it is continued.

"18. In accordance with this fact it will be found that in chloroform administration neither holding the breath, even if involuntary, or vagus inhibition can be kept up beyond a certain time; and if the chloroform is not removed from the face, one or both of two things happen: (1) when the animal breathes again it takes deep and gasping inspirations, the lungs become filled with chloroform, and an overdose is taken in with extreme rapidity; or (2) when the restraining influence of the vagus is taken off the heart, through the irritation ceasing or the nerve becoming exhausted, the heart bounds on again, and the circulation is accelerated in proportion. The blood then becomes quickly saturated with chloroform, and an overdose is at once conveyed to the nerve-centres. [We believe this is true of the healthy heart, but not of one engorged with blood which has undergone fatty degeneration. This is only an hypothesis, however, as we have no experimental basis for this belief (Hare and Thornton).] The theory which has hitherto been accepted is that the danger in chloroform administration consists in the slowing or stoppage of the heart by vagus inhibition. This is now shown to be absolutely incorrect. There is no doubt whatever that the controlling influence of the vagus on the heart is a safeguard, and that it is the exhaustion of the nerve which is dangerous. [We believe that this conclusion is more theoretical than practical (Hare and Thornton).]

"19. It can be readily understood how a condition in which the pulse is rapid and bounding, with high blood-pressure, leads to more rapid absorption of chloroform from the lungs and a more rapid propulsion of the chloroformed blood to the medulla oblongata, and consequently to a more rapid paralysis of the respiratory and vaso-motor centres and pre-

cipitous fall in the blood-pressure. Such a condition is produced in some cases by ether or by division of both vagi, or by a full dose of atropine. Not only is the poisoned blood carried more swiftly to the vital centres in these cases, but added to this there is the fact that as the heart is already doing its utmost before the chloroform is given, it is unable to stave off by increased work the fall in pressure that occurs when the vaso-motor centre is paralyzed. On the other hand, it seems clear from Experiment 92 that the direct action of chloroform upon the heart's substance is not the cause of the fall of pressure that occurs when it is inhaled.

[That we (Hare and Thornton) agree in general with these conclusions (paragraphs 15, 16, 17, 18, and 19) is shown by the following extract from the research of Wood and Hare in the *Medical News*, February 22, 1889:

"The theory has from time to time found advocates that the vapors of chloroform may, by irritating the larynx and adjacent parts, cause arrest of the heart through a reflex inhibition. To test the possibility of this, we have made a number of experiments. When the tracheal canula is tied tightly into the trachea some distance below the larynx, it is evident that the latter organ is isolated from the general respiratory tract, and that chloroform injected into it will exert only a local influence. In all the experiments which we have made in the way just indicated, the injection has been followed by an immediate and very pronounced primary fall of the pressure, followed, after a very brief interval, by a rise, which usually reaches decidedly above the norm. As an example of one of these experiments, we give the preceding tracing. [See Tracing 1, Wood and Hare, here appended.]

"The primary fall of arterial pressure, which has just been spoken of, can scarcely be produced except by reflex inhibition of the heart or of the vaso-motor centres, while the secondary rise is probably the result of a reflex vaso-motor spasm. In order to throw light upon this question, we have made experiments by injecting chloroform into the larynx after division of the pneumogastric nerves, the trachea being ligated so as to prevent the entrance of the anæsthetic into the lungs. [See Tracing 2, Wood and Hare, here appended.]

"In making practical application of the experiments thus discussed, it must be noted that in no case have we succeeded in completely arresting the heart's action by injecting chloroform into the larynx, and as the chloroform was injected in liquid form, it is plain that the irritation was more intense than could be produced by the mere vapors of the anæsthetic, however concentrated; therefore, while it must be considered that it is possible for a reflex inhibitory arrest of the heart to occur during the inhalation, such an accident is extremely improbable, and we consider it practically certain that a heart so arrested could, a few seconds later escaping from the inhibitory control, recommence its beat. [See our Experiment 15 (Hare and Thornton).] It certainly has never been proved that chloroform can cause in the human subject permanent reflex inhibitory cardiac arrest, and as our experiments upon the dog have failed to cause arrest, we consider it very improbable that reflex cardiac arrest is ever produced in man by chloroform." To this we wish to add, unless the cardiac disease or condition is such as to be unable to withstand any shock whatever (Hare and Thornton).]

"20. In Experiment 92 repeated injections of 20 minims of chloroform were made into the jugular vein, and its effect was not to paralyze the heart, but to produce anæsthesia and a gradual fall of blood-pressure, exactly as if the chloroform had been inhaled. In Experiment 72, after a considerable amount of ether had been injected into the jugular vein and a bounding condition of pulse had been produced, the effect of injecting chloroform into the jugulars was much greater and the fall of blood-pressure much more rapid and dangerous than is the case when chloroform alone was injected. Granting, then, the truth of Ringer's conclusions from experiments on the frog's heart (which have not been repeated and confirmed by the Commission), that chloroform has a gradual paralyzing effect upon the heart's tissue, we must conclude that such an effect, in the degree in which alone it could occur in the practical inhalation of chloroform, would rather be a source of safety than of danger. [With these conclusions we have to entirely disagree, and we cannot understand how results so completely at variance with our own and with those of Wood and Hare could have been arrived at. (See Tracings Nos. 19 and 20.) The tracings we present do not admit of wrong interpretation. Perhaps the difference lies in the fact that in our studies enough water was added to the chloroform to carry it *en masse* to the heart, whereas in the East Indian studies the pure undiluted drug was injected, and had not sufficient volume to reach the heart, and was gradually volatilized in the vein, and so produced a gradual effect. (This is shown in Tracing No. 8, Hare and Thornton.) We find the in-

jection of from 2 to 4 cubic centimetres of chloroform into the jugular vein causes arrest of respiration, rapidly followed by cardiac arrest, which is not secondary to the respiratory failure, but to a primary action of the chloroform on the heart-muscle, which is found more responsive to stimulation. We have made this experiment over one hundred times.

It having been denied that chloroform, when injected into the jugular vein, causes cardiac depression, and the recent experiments of Leaf and his colleagues in Hyderabad having been cited to support this view, let us discuss the facts before us. In these researches they found when chloroform was given in excessive amount, that the pen fell to the abscissa line and failed to record a pulse-wave, but that a needle in the heart-muscle continued to beat for many seconds. While at first glance these results, which we have also obtained (see our Experiments 19 and 20), seem to prove that the cardiac arrest is only apparent and not real, in reality they have been given an importance far in excess of their value. We have proved again and again that the movement of the needle may be due, not to a true cardiac contraction, but to inco-ordinated contraction of one of the ventricles, and to contractile movements of bands of the cardiac muscle, which movements are very often rhythmical enough to make the needle beat regularly. We have found this needle movement taking place even after an injection of chloroform had been sent directly into the heart through the chest-wall, and in a heart the muscle of which failed to respond to any strength of faradic irritation, except in those parts which had not come in contact with the poison.

Further than this, if an animal be given very large doses of chloroform intravenously or by direct intracardiac injection, respiration invariably ceases if the amount be large enough, and if the chest be opened one condition will be constantly found,—viz., the heart so widely dilated as to fill the pericardium almost to bursting, and the cavities, particularly the ventricles, engorged with blood. Although they may still be feebly contracting, the contraction is abortive and fails to cause arterial flow. If the drug has been used intravenously, by the jugular, the blood in the right and left heart will be found red, provided death has come on rapidly. If not, it will be dark and venous. The lungs will be found of that peculiar pink hue due to altered blood. If the injection has been cardiac, it will be found that the ventricle with which the poison has come in direct contact has become paralyzed, while the other is making fairly good efforts to work. (See our Experiment 21, Hare and Thornton.) When the injection takes place into the right ventricle, so that the poison passes to the left cavity, both ventricles fail to act voluntarily or to faradism. (See our Experiment 25, Hare and Thornton.) Chloroform is capable, therefore, of causing death of the cardiac muscle whenever it comes in contact with it, and that there is no possibility of this arrest being due to vagal irritation is proved by experiments in which vagal section preceded the use of the chloroform. (See our Experiments 22, 24, and 25.) We doubt whether the last sentence of paragraph 20 is justified by our present knowledge.]

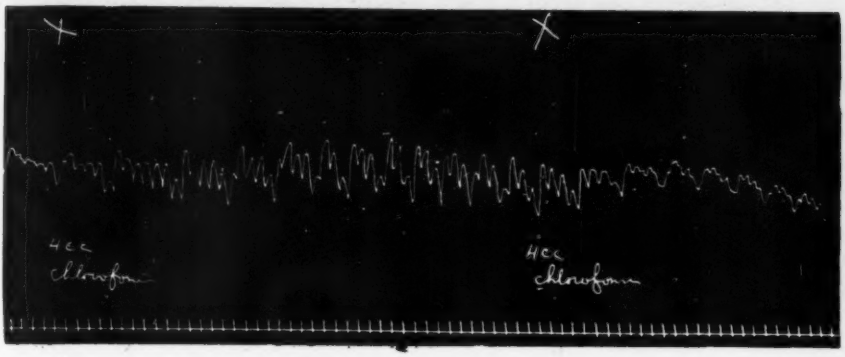
"21. The committee discussed the advisability of cutting the vagi some time previous to experimenting on the blood-pressure with chloroform. The effect of this procedure is to cause continuous rapid action and tendency to exhaustion of the heart, as well as to degeneration of the terminal branches of the nerves in the heart if the animal lives sufficiently long. Such experiments might be of some interest theoretically, and also have had a practical bearing upon the condition of the heart in certain cases of chronic alcoholism; but the committee decided not to perform them, as they considered the end to be gained did not justify the pain they would have inflicted. [We have not made this particular experiment, but we found that vagal section immediately before the drug was used did not materially alter the result.]

"22. In Experiment 178, the case of a dog that had had morphine, remarkable slowing and even temporary cessation of the heart's action occurred again and again at the same moment as the respiration stopped, but the heart invariably recovered itself and began again to beat regularly before any steps were taken to restore the animal, and without any respiration occurring. We found in this case that it was possible to restore the animal even after unusually long intervals had been allowed to elapse between the cessation of natural and the commencement of artificial respiration. The failure of the heart, if such it can be called, instead of being a danger to the animal, proved to be a positive safeguard by preventing the absorption of the residual chloroform and its distribution through the system. [We have not made any experiments on this point.]

"23. The effect of artificial respiration after the natural respiration has ceased is to cause an alternate rise and fall of small amount in the blood-pressure, the trace thus formed upon the drum being a coarse imitation—altered somewhat by the shaking of the table—of the nat-

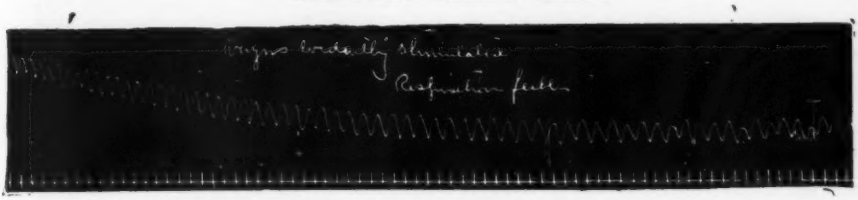
Experiment No. 1.

This tracing shows how the depression of pressure under chloroform is only temporary and followed by a rise if chloroform is stopped for a moment. Slight rise seen in Part III. It also shows how, if chloroform is pushed, respiration and circulation are hopelessly depressed, the respiration stopping first.



Dog, weight twenty kilos. Chloroform given on towel closely applied to head. Twelve cubic centimetres of chloroform given in the two minutes preceding the beginning of this tracing. Struggling from first inhalation very slight.

Tracing No. 1—*Continued.* Part II.



Without pause.

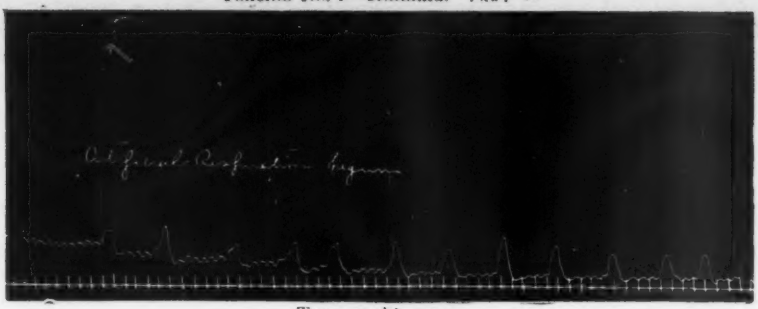
Tracing No. 1—*Continued.* Part III.

No pause. Shows slight rise of pressure.

Tracing No. 1—*Continued.* Part IV.

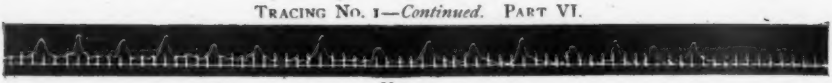
No pause.

TRACING No. 1—*Continued.* PART V.



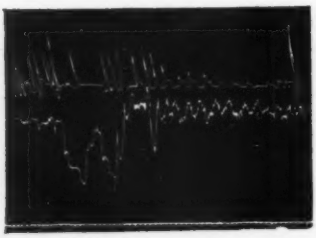
Ten seconds' pause.

TRACING No. 1—*Continued.* PART VI.

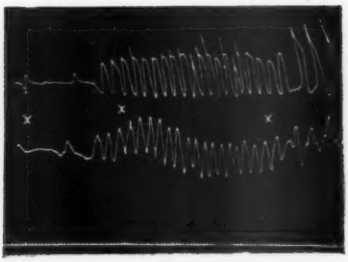


No pause.

TRACING No. 1 (Wood and Hare).

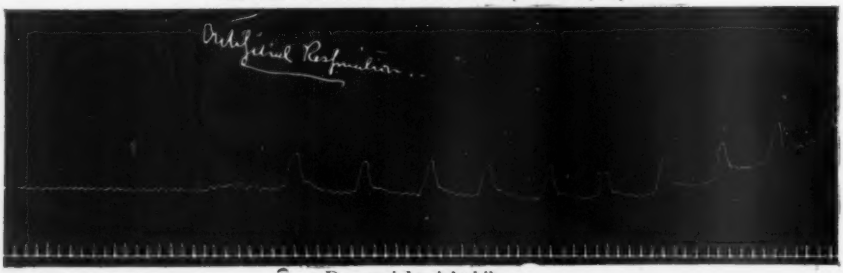


TRACING No. 2 (Wood and Hare).



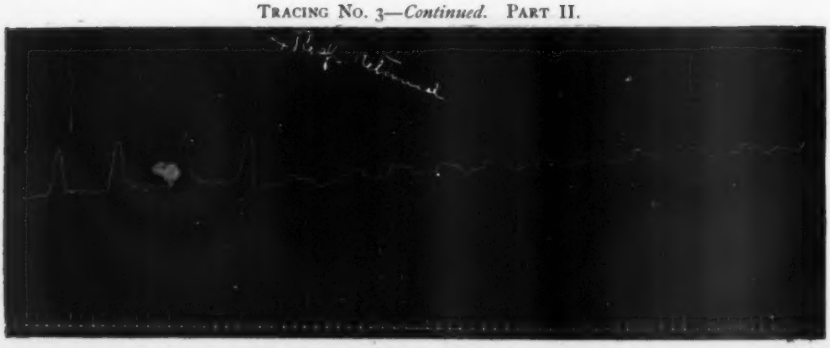
TRACING No. 3. PART I.

This tracing shows how artificial respiration causes a return of breathing and pressure. Respiration was stopped by ten cubic centimetres of chloroform, pushed rapidly.

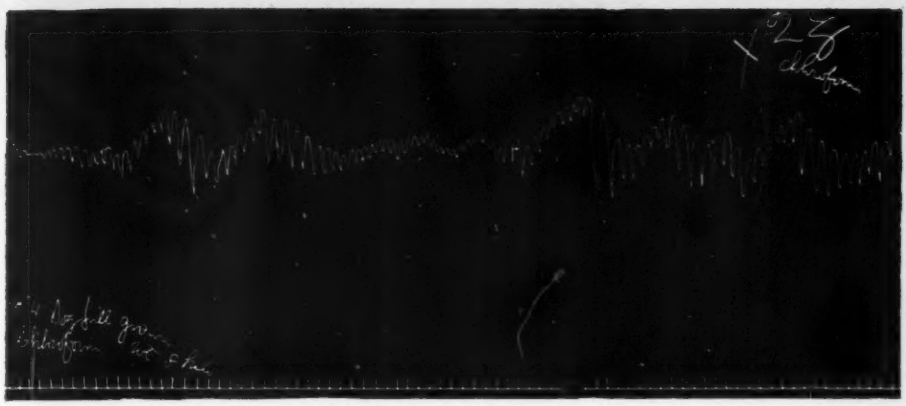


Dog, weight eight kilos.

TRACING No. 3—*Continued.* PART II.

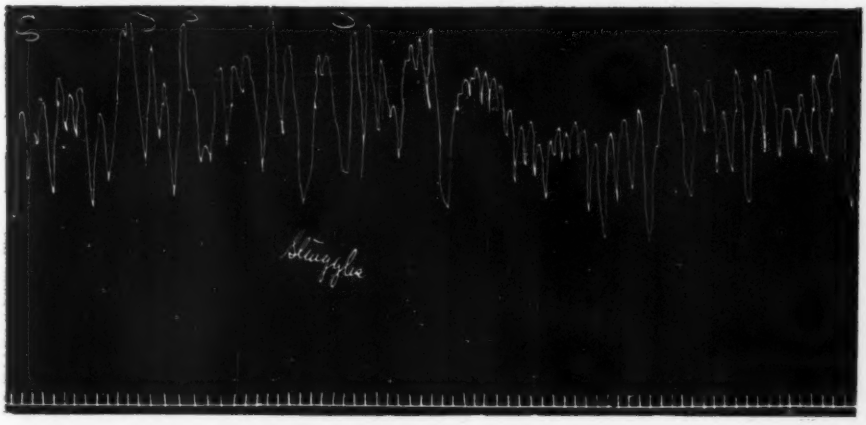


TRACING No. 4. PART I.



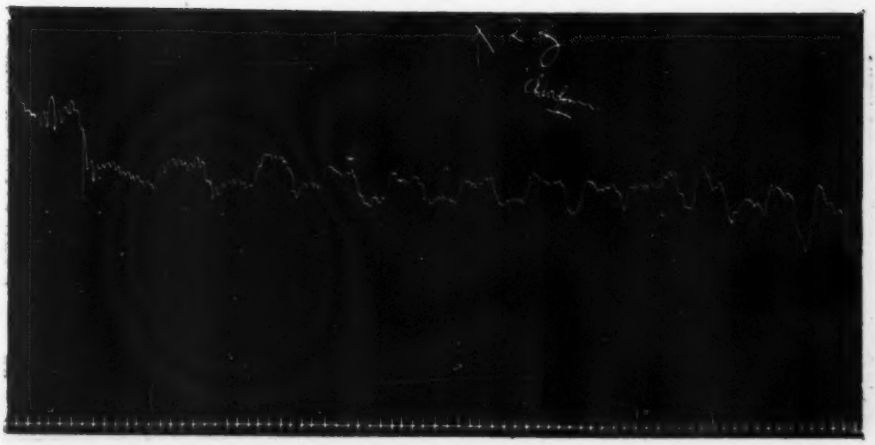
Shows that with anæsthesia there always ensues a fall of arterial pressure. There is also a gradual failure of heart-force, as seen particularly in Parts VII. and VIII. in this tracing.

TRACING No. 4—*Continued.* PART II.



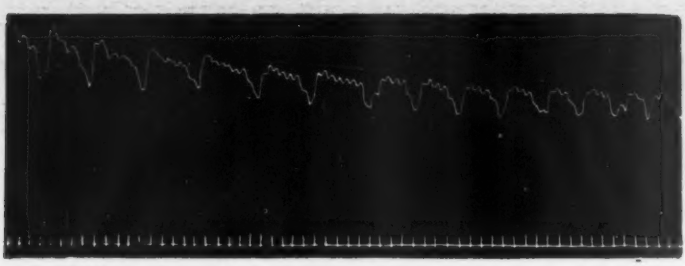
No pause.

TRACING No. 4—*Continued.* PART III.



No pause.

TRACING No. 4—*Continued.* PART IV.



No pause.

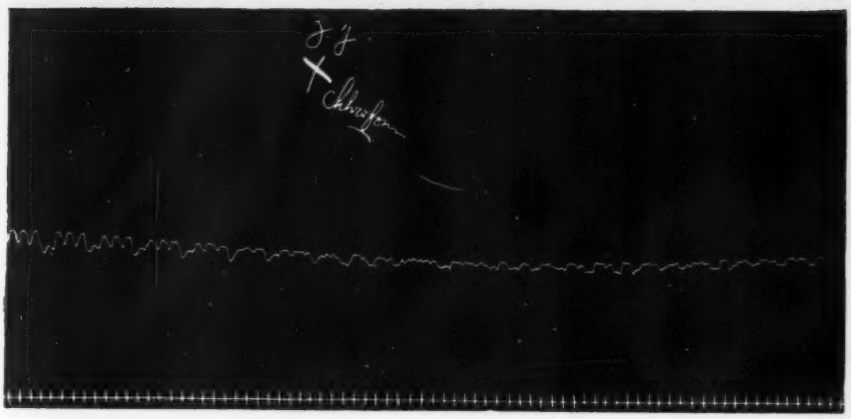
TRACING No. 4—*Continued.* PART V.

No pause.

TRACING No. 4—*Continued.* PART VI.

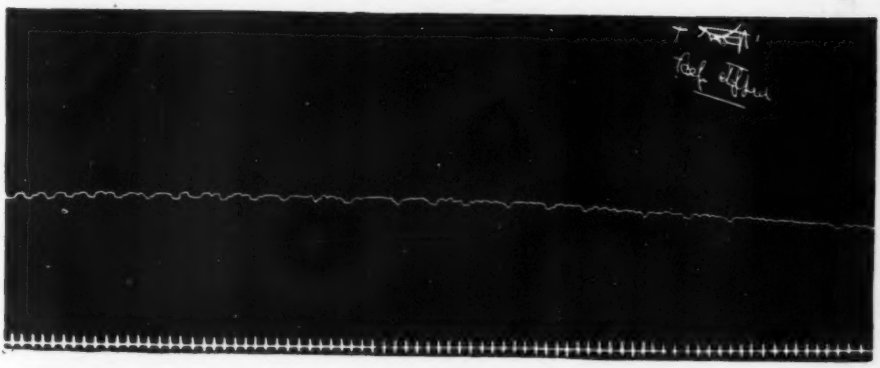
No pause.

TRACING No. 4—*Continued* PART VII.



No pause.

TRACING No. 4—*Continued.* PART VIII.

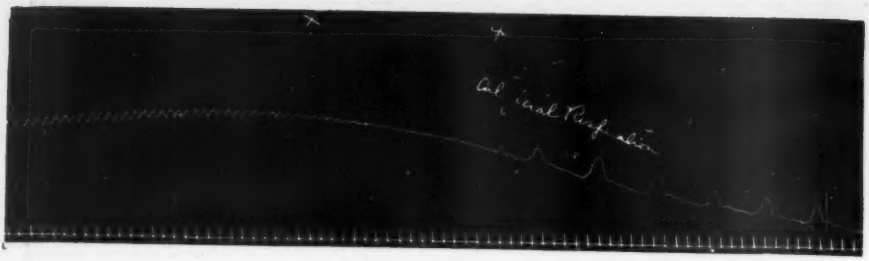


No pause.

TRACING No. 5. PART I.

Weight ten kilos. Chloroform given on Esmarch inhaler to the amount of twenty cubic centimetres in preceding ten minutes. Artificial respiration instituted as soon as voluntary respiration ceased at first × mark; failed to restore respiration and to preserve circulation. See Part II. of this tracing

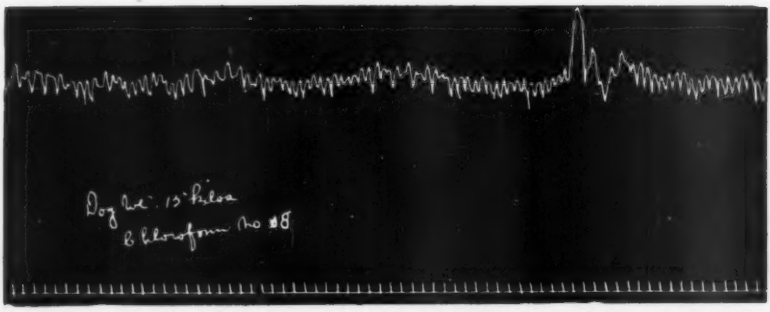
TRACING No. 5—*Continued.* PART II.



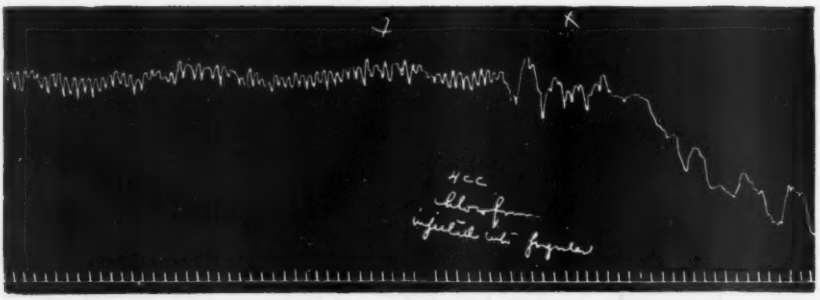
Respiration stopped at first × mark.

TRACING No. 5—*Continued.* PART III.

TRACING No. 8. PART I.

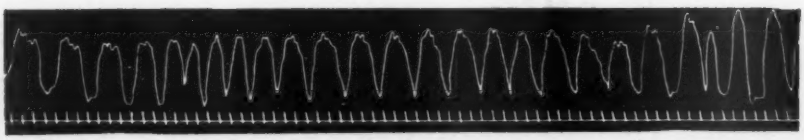


TRACING No. 8—*Continued.* PART II.



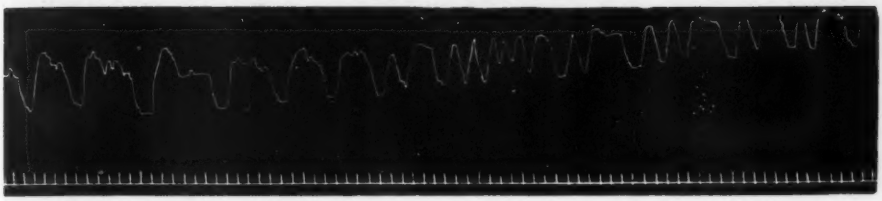
No pause.

TRACING No. 8—*Continued.* PART III.



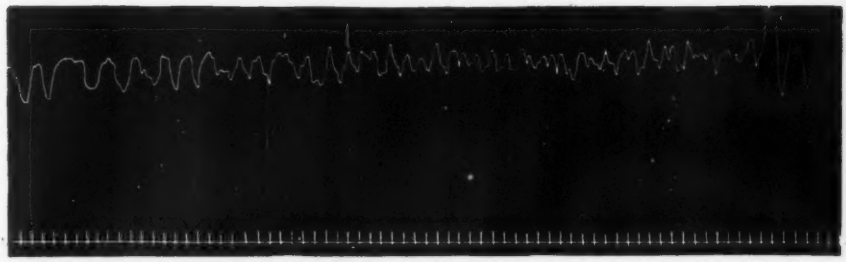
No pause.

TRACING NO. 8—*Continued.* PART IV.



Two minutes since Part III.

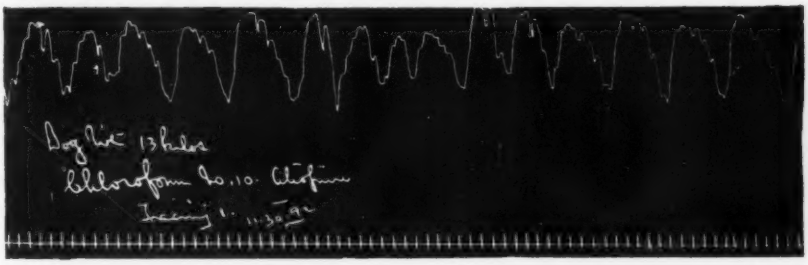
TRACING NO. 8—*Continued.* PART V.



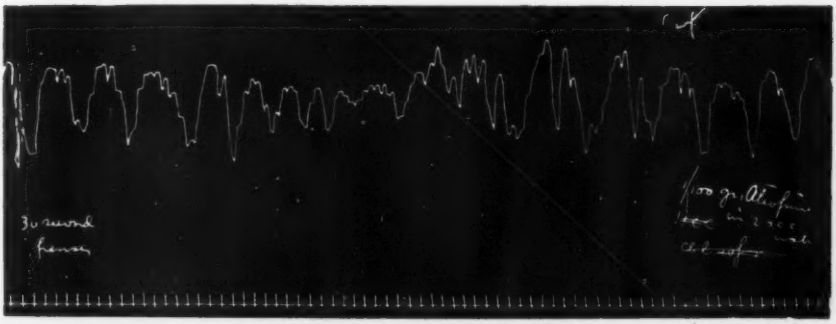
No pause.

TRACING NO. 10. PART I.

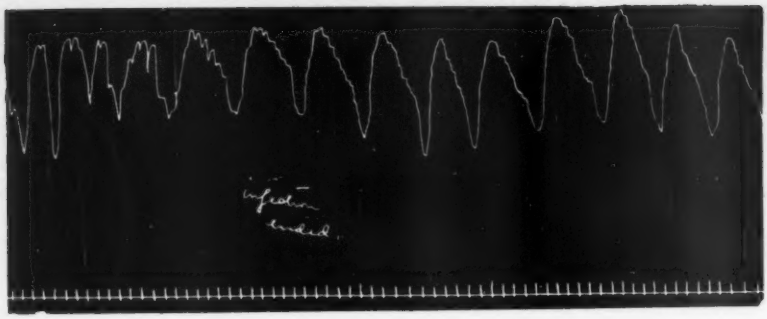
This tracing shows how, if chloroform is pressed, the respiration finally ceases, and the circulation is persistently depressed; also, that atropine prevents a rapid fall of pressure.



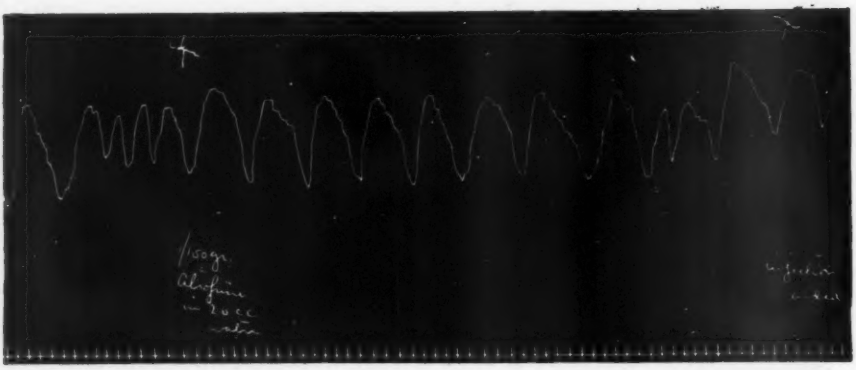
TRACING NO. 10—*Continued.* PART II.



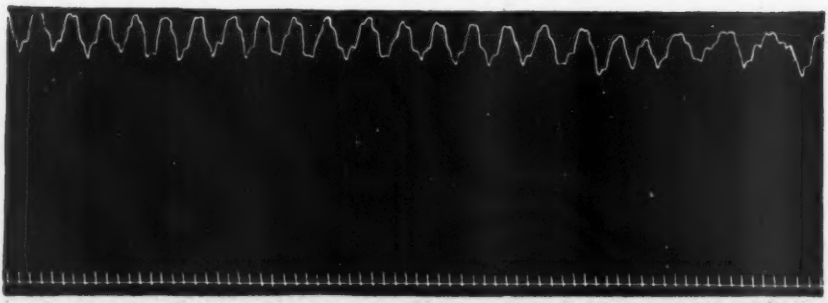
TRACING NO. 10—*Continued.* PART III.



TRACING NO. 10—*Continued.* PART IV.

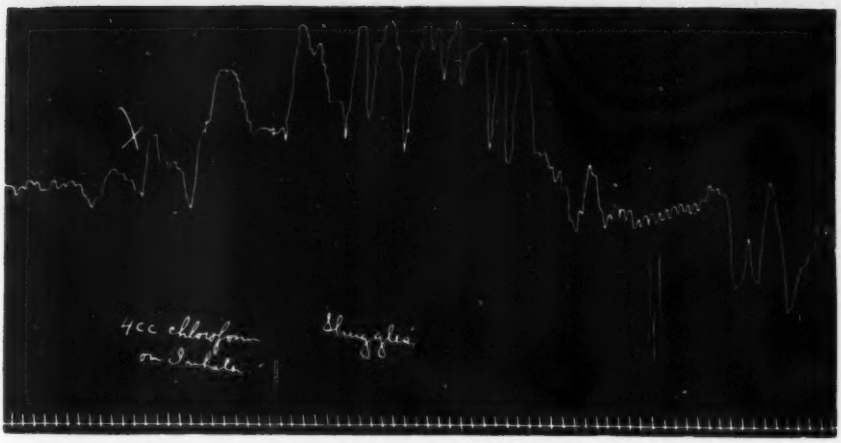


TRACING NO. 10—*Continued.* PART V.

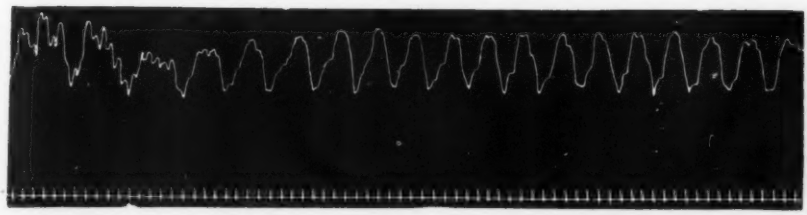


A pause of one and one-half minutes between this part and Part IV.

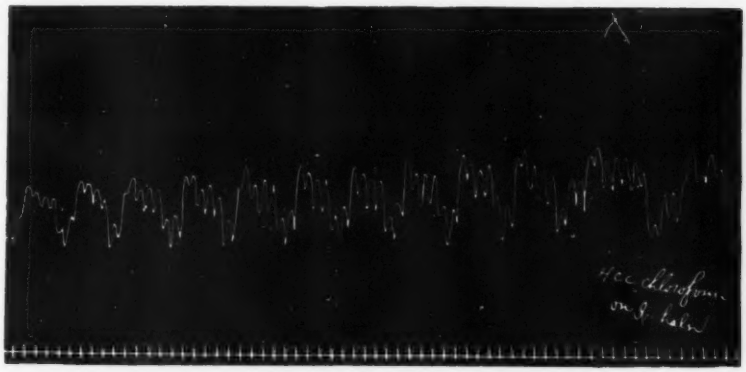
TRACING NO. 10—*Continued.* PART VI.



TRACING NO. 10—*Continued.* PART VII.

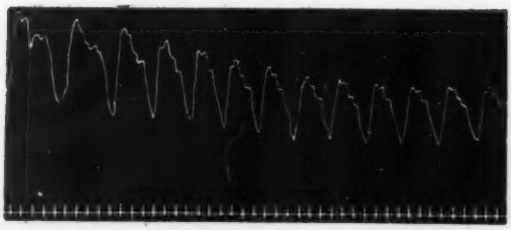


TRACING NO. 10—*Continued.* PART VIII.



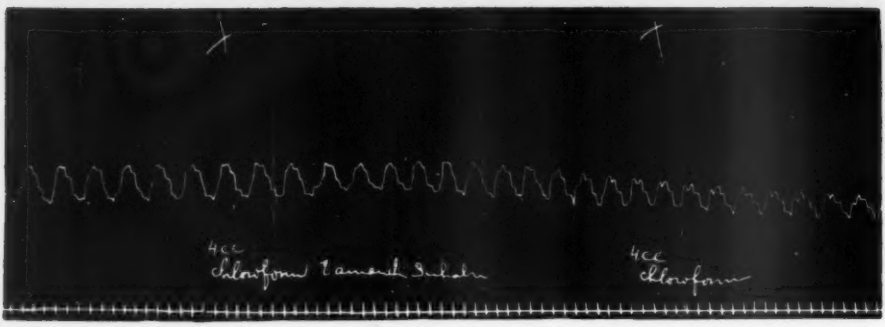
No pause.

TRACING NO. 10—*Continued.* PART IX.



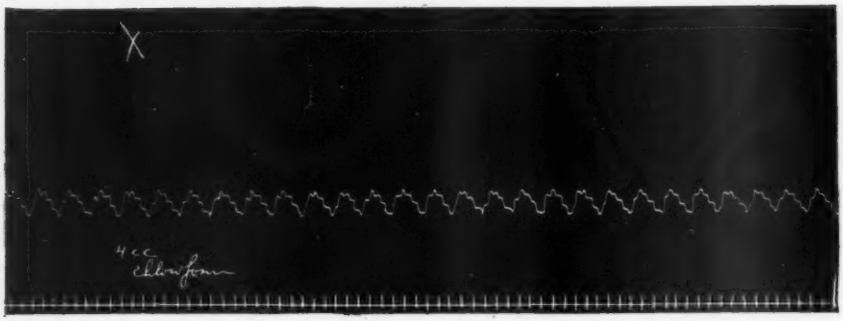
No pause.

TRACING NO. 10—*Continued.* PART X.



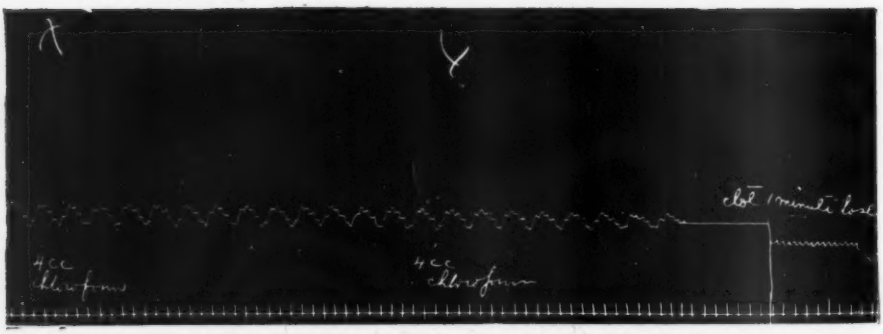
Two minutes' pause in changing drum.

TRACING NO. 10—*Continued.* PART XI.



No pause.

TRACING NO. 10—*Continued.* PART XII.



No pause.

TRACING NO. 10—*Continued.* PART XIII.

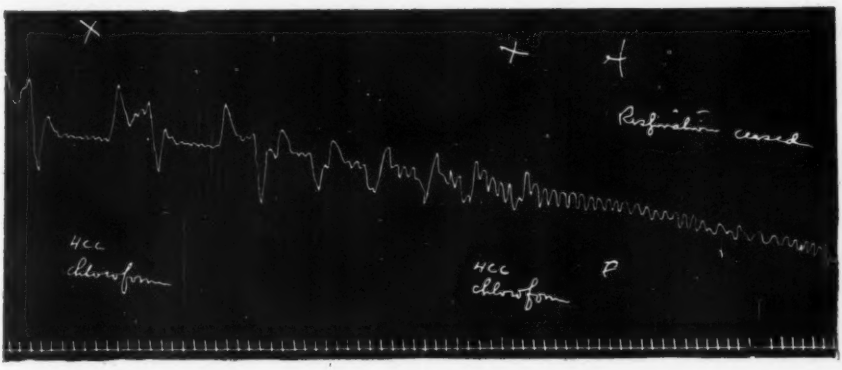
No pause.

TRACING NO. 10—*Continued.* PART XIV.

No pause.

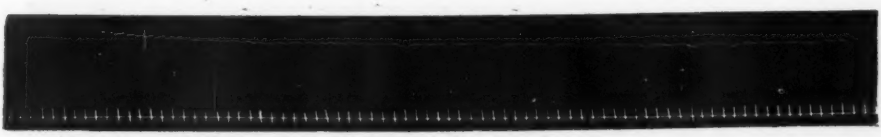
TRACING NO. 12. PART I.

This tracing shows how the pulse and respiration may apparently cease finally, yet return after some moments, and then fail again, the respiration stopping first, the heart finally being in good condition. See Part V.



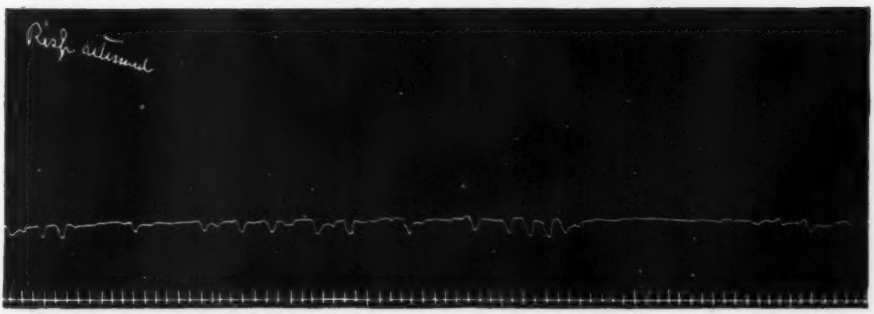
Dog, weight ten kilos. Four cubic centimetres of chloroform given thirty seconds before this tracing begins.

TRACING NO. 12—*Continued.* PART II.



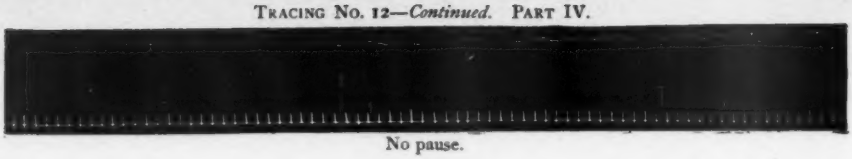
No pause.

TRACING NO. 12—*Continued.* PART III.



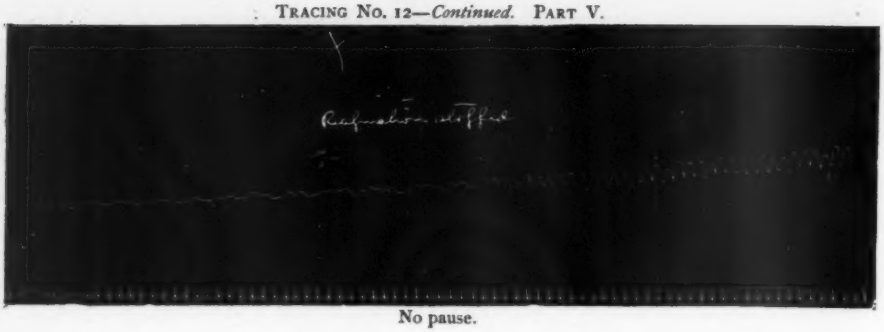
No pause.

TRACING NO. 12—*Continued.* PART IV.



No pause.

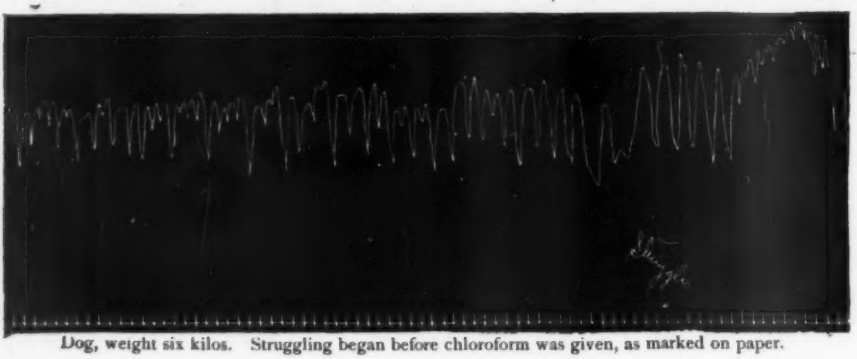
TRACING NO. 12—*Continued.* PART V.



No pause.

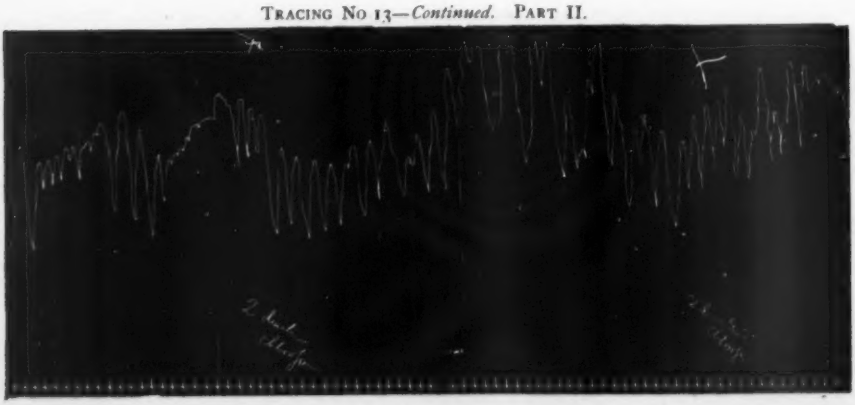
TRACING NO. 13. PART I.

This tracing shows characteristic fall of blood-pressure under chloroform, the irregular pulse due to struggling, and the effect of primary irritation of the vagal and trigeminal nerves. It also shows how, when the arterial pressure and heart-action seem practically *nil*, recovery of both may occur, if the chloroform is not pushed. Also recovery of respiration voluntarily. (See Parts VI., VII., XI., and XIV. of this experiment.) Also shows how, when chloroform is pushed, there comes a time when respiration ceases finally and pressure falls very low. (See Parts XV. and XVI.) As usual, respiration ceased before heart.

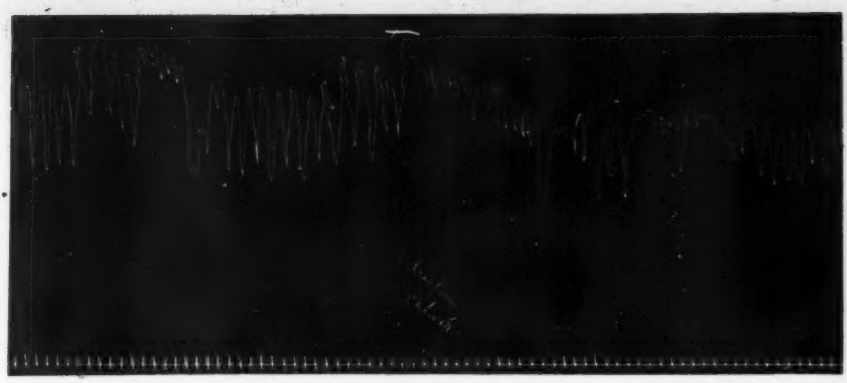


Dog, weight six kilos. Struggling began before chloroform was given, as marked on paper.

TRACING NO 13—*Continued.* PART II.

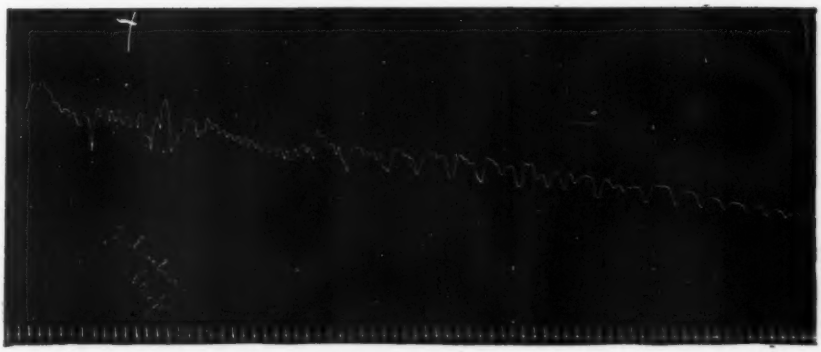


TRACING NO. 13—*Continued.* PART III.



No pause.

TRACING NO. 13—*Continued.* PART IV.

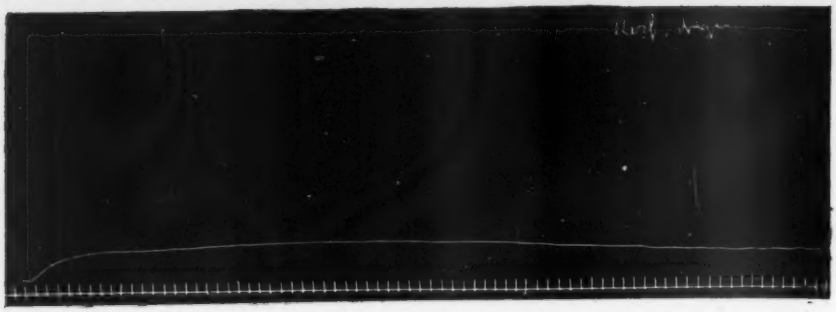


No pause.

TRACING NO. 13—*Continued.* PART V.

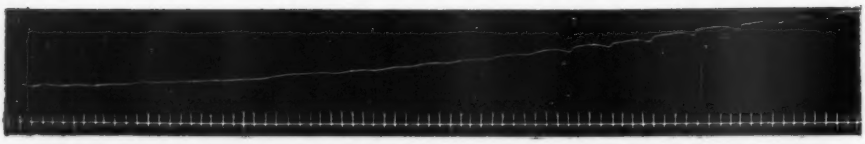
No pause.

TRACING No. 13—*Continued.* PART VI.

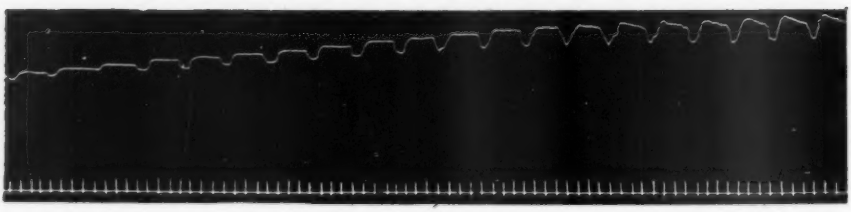


A pause of twenty seconds, owing to pen getting caught in thread. During this pause pen fell to point shown in very beginning of this tracing.

TRACING No. 13—*Continued.* PART VII.

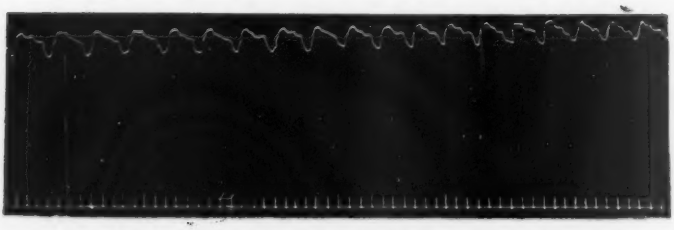


TRACING No. 13—*Continued.* PART VIII.



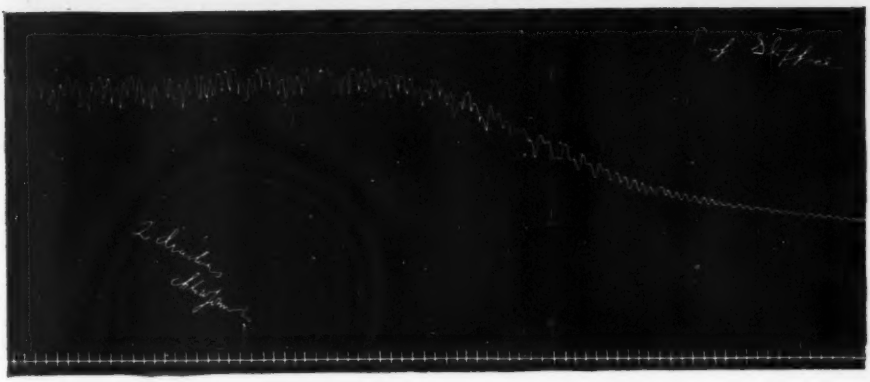
No pause.

TRACING No. 13—*Continued.* PART IX.



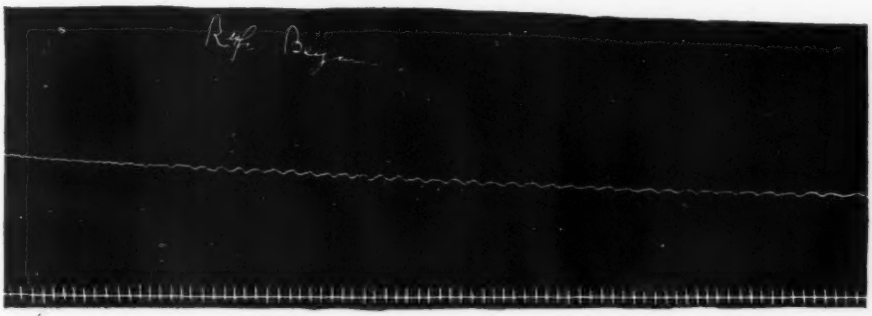
No pause.

TRACING NO. 13—*Continued.* PART X.



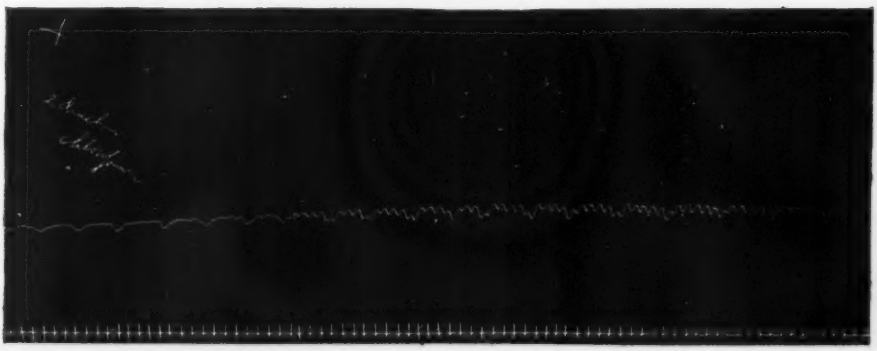
Beginning of another paper on second drum. About forty seconds lost in removing first drum and placing second drum in place. Shows complete restoration of blood-pressure.

TRACING NO. 13—*Continued.* PART XI.



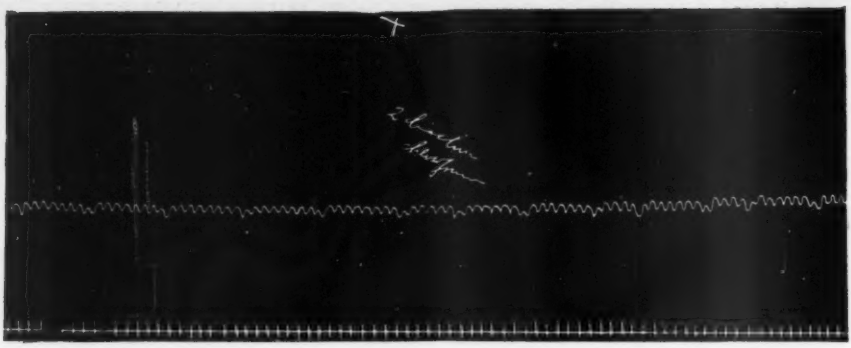
No pause.

TRACING NO. 13—*Continued.* PART XII.



No pause.

TRACING No. 13—*Continued.* PART XIII.

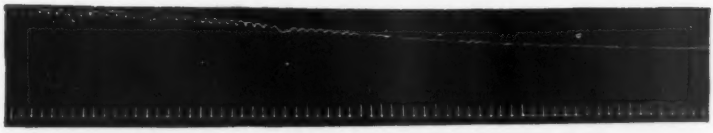


No pause.

TRACING No. 13—*Continued.* PART XIV.

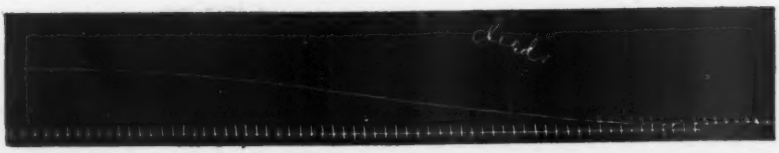
No pause.

TRACING No. 13—*Continued.* PART XV.



No pause.

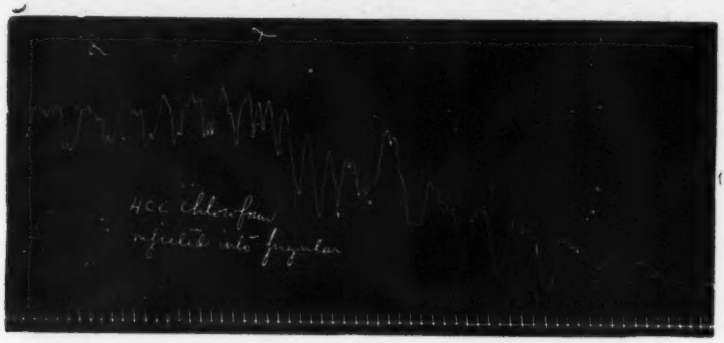
TRACING No. 13—*Continued.* PART XVI.



No pause.

TRACING No. 14. PART I.

This tracing shows that an animal apparently dead from cardiac failure caused by chloroform has a temporary return of heart-action.

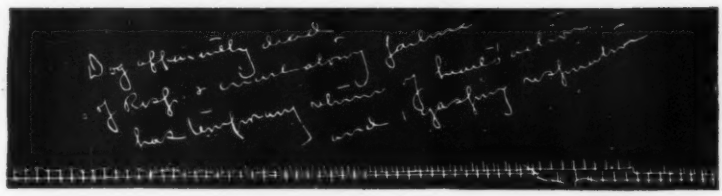


Dog, weight six kilos. Four cubic centimetres of chloroform injected into jugular.

TRACING No. 14—*Continued.* PART II.

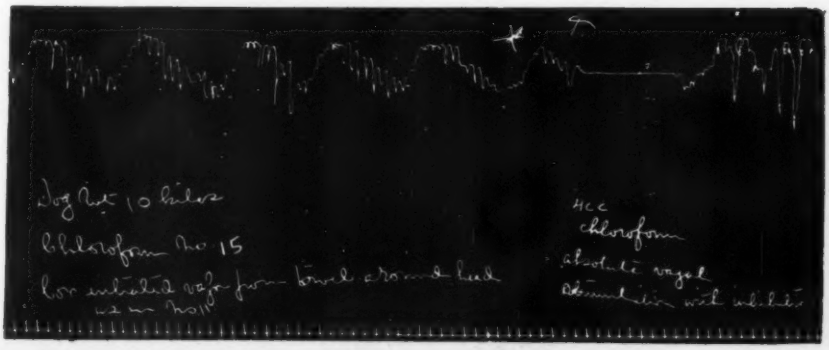
No pause.

TRACING No. 14—*Continued.* PART III.



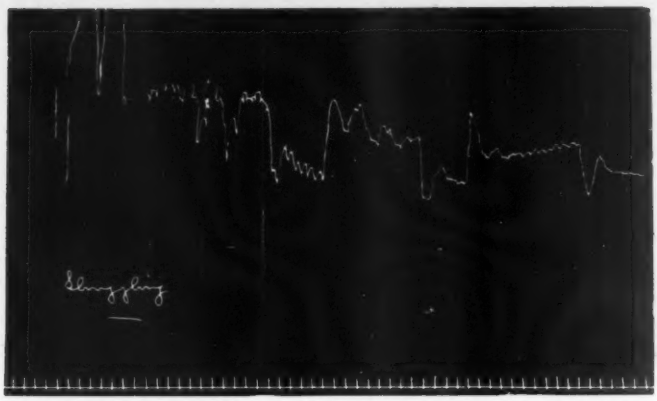
Thirty seconds' pause.

TRACING No. 15. PART I.



Chloroform in concentrated vapor from towel tightly around head.

TRACING No. 15—*Continued.* PART II.

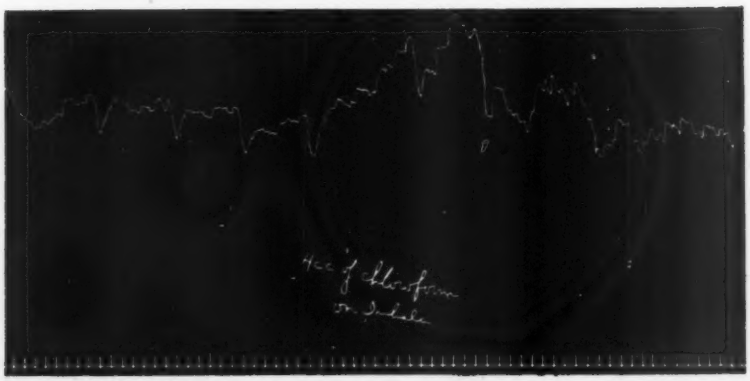


No pause.

TRACING No. 16. PART I.

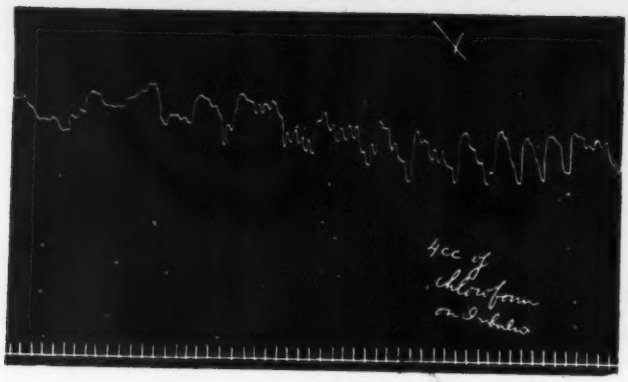
This tracing shows that chloroform, even when given very freely in four cubic centimetre doses, does not lower blood-pressure as rapidly when atropine is given as when it is not. It also shows how, when chloroform is pushed, the respiration finally ceases and the pressure falls lower and lower. See Parts X., XI., and XII.

TRACING No. 16—*Continued.* PART II.



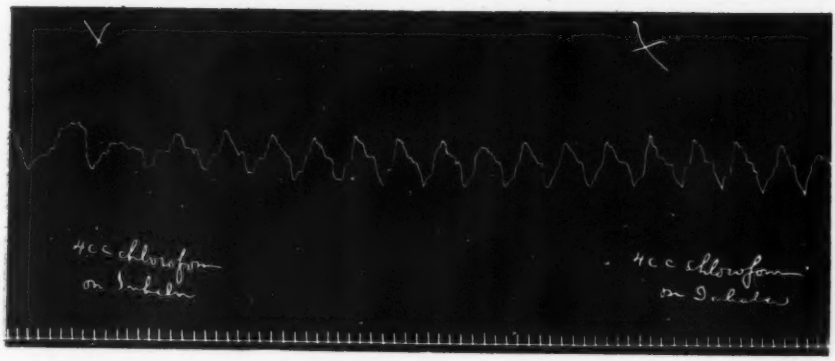
No pause.

TRACING No. 16—*Continued.* PART III.



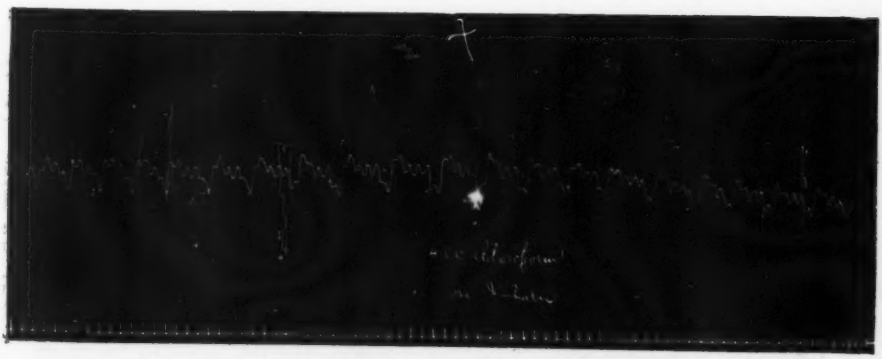
No pause.

TRACING No. 16—*Continued.* PART IV.



No pause.

TRACING No. 16—*Continued.* PART V.

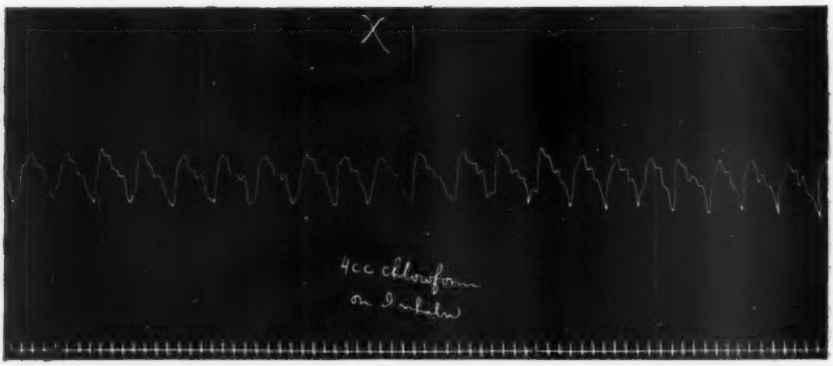


No pause.

TRACING No. 16—*Continued.* PART VI.

No pause.

TRACING No. 16—*Continued.* PART VII.

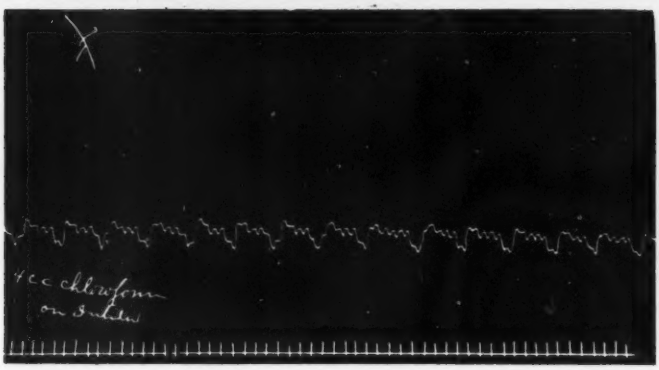


No pause.

TRACING No. 16—*Continued.* PART VIII.

No pause.

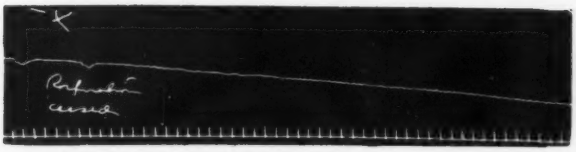
TRACING No. 16—*Continued.* PART IX.



TRACING No. 16—*Continued.* PART X.

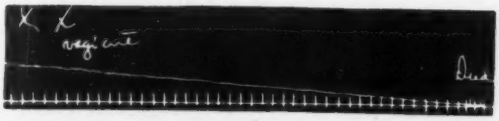
No pause.

TRACING No. 16—*Continued.* PART XI.



No pause.

TRACING No. 16—*Continued.* PART XII.

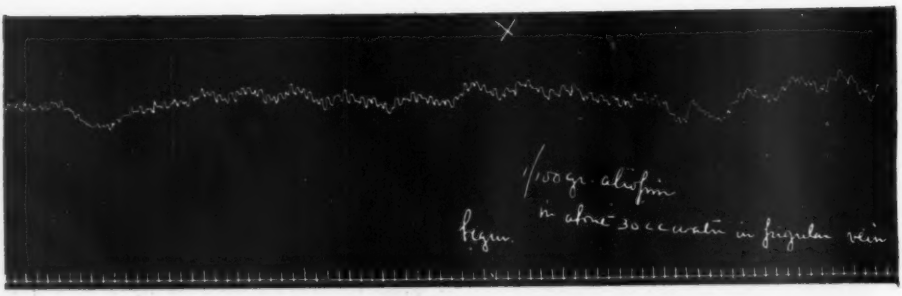


No pause. The section of the vagi was made to see if any effect would result, and not because it was thought these nerves were stimulated.

Tracing No. 17. Part I.

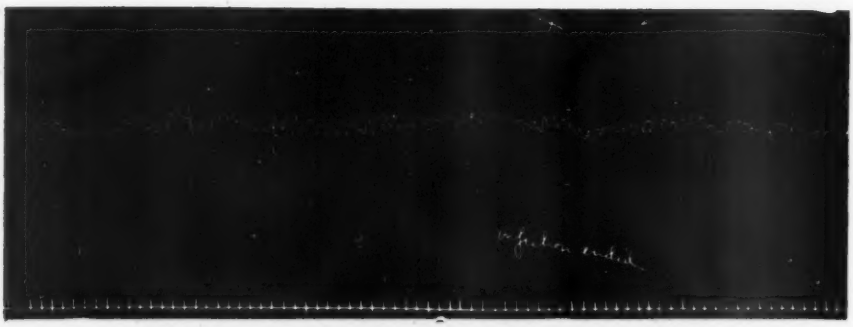
This tracing shows how chloroform may so depress the circulation as to make one think the animal is dead, but the heart, if given time, regains its action. (See Parts IX., X., and XI.) It also shows how, if chloroform is pushed, the respiration stops and the pressure falls (see Parts XIII., XIV., XV., and XVI.), and that the respiration may begin spontaneously as the pressure rises. (See Parts X. and XIII.)

Tracing No. 17—*Continued.* Part II.



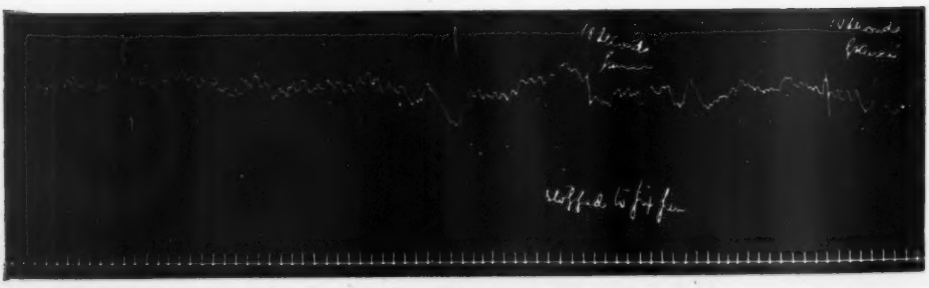
No pause.

Tracing No. 17—*Continued.* Part III.



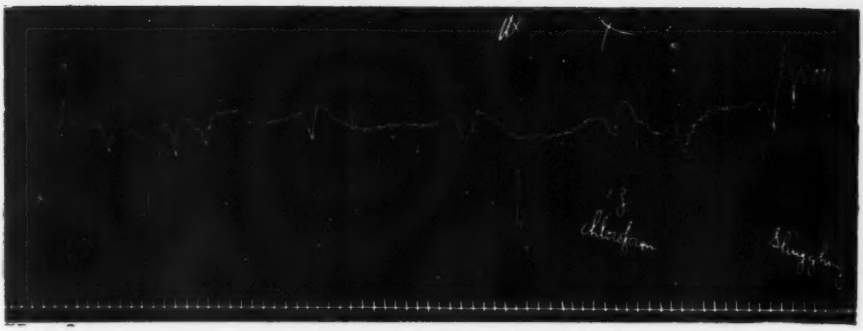
No pause.

Tracing No. 17—*Continued.* Part IV.



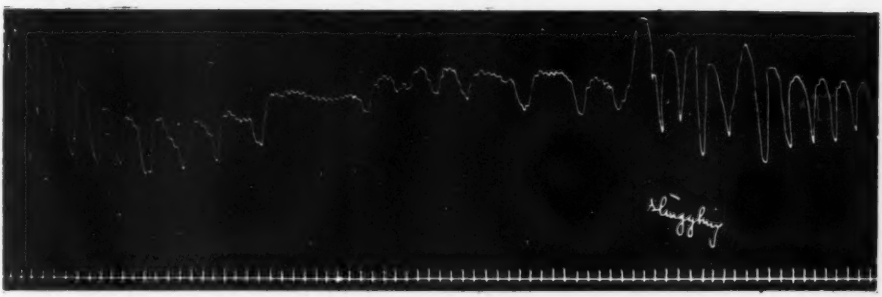
No pause.

TRACING NO. 17—*Continued.* PART V.



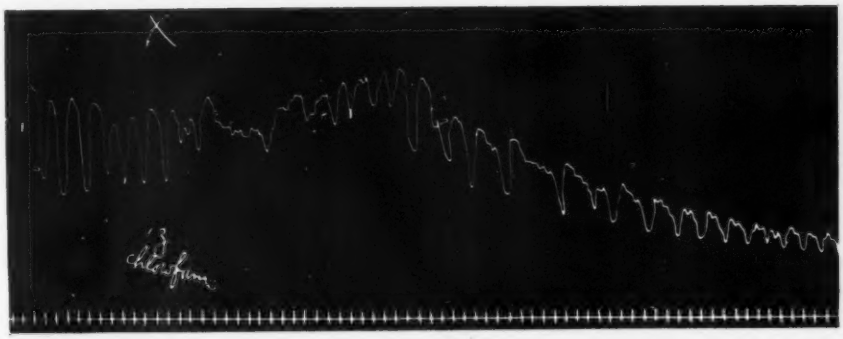
Pause of twenty seconds.

TRACING NO. 17—*Continued.* PART VI.



No pause.

TRACING NO. 17—*Continued.* PART VII.

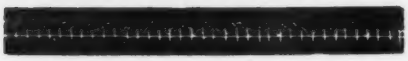


No pause.

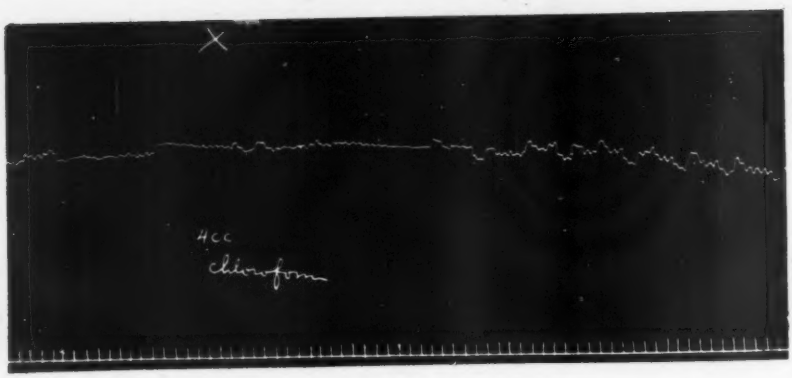
TRACING NO. 17—*Continued.* PART VIII.

No pause.

TRACING No. 17—*Continued.* PART IX.

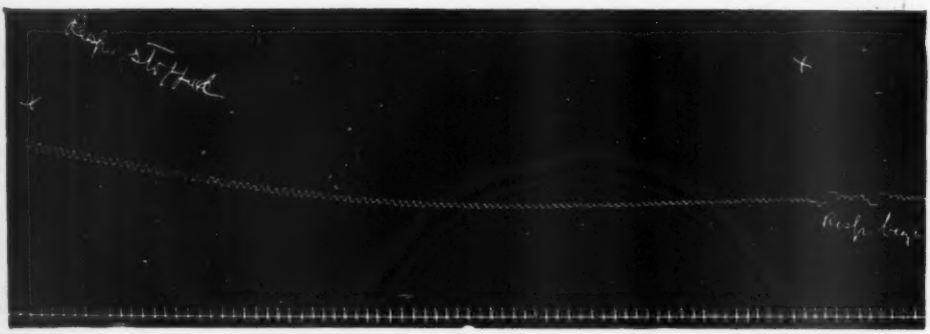


TRACING No. 17—*Continued.* PART X.



Four minutes lost in changing drum. During this time no chloroform was given. Tracing shows recovery of blood-pressure. Respiration returned during pause.

TRACING No. 17—*Continued.* PART XI.

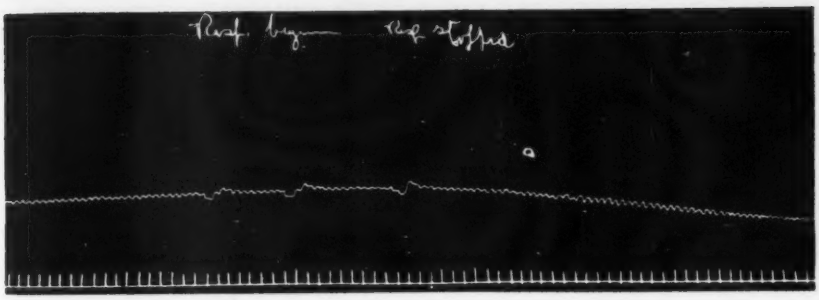


No pause.

TRACING No. 17—*Continued.* PART XII.

No pause.

TRACING No. 17—*Continued.* PART XIII.



No pause.

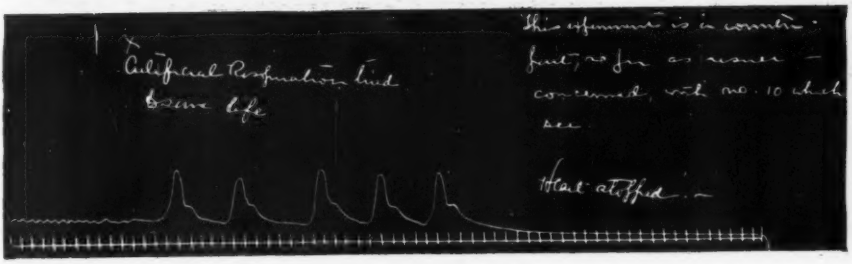
TRACING No. 17—*Continued.* PART XIV.

No pause.

TRACING No. 17—*Continued.* PART XV.

No pause.

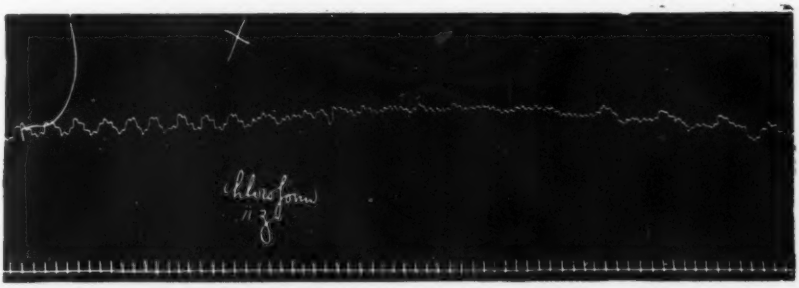
TRACING No. 17—*Continued.* PART XVI.



No pause.

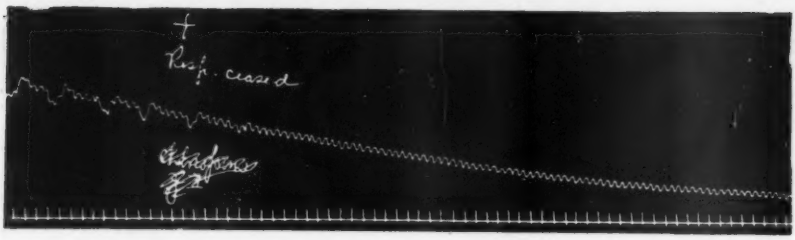
TRACING No. 18. PART I.

This tracing shows very long circulatory maintenance when atropine is given. It also shows how, when chloroform is pushed, it finally causes arrest of respiration and fall of pressure.



Dog, weight seven kilos. This is beginning of second drum. During first drum (ten minutes) he had received $\frac{1}{100}$ grain of atropine and two drachms (eight cubic centimetres) of chloroform every minute, or eighty cubic centimetres. As this first drum-tracing is a counterpart of No. 17, it is not given.

TRACING No. 18—*Continued.* PART II.

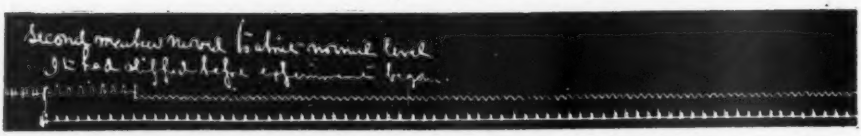


No pause.

TRACING No. 18—*Continued.* PART III.

No pause.

TRACING No. 18—*Continued.* PART IV.

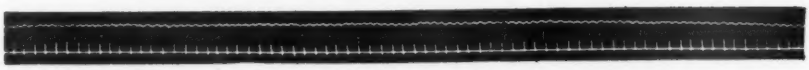


No pause.

TRACING No. 18—*Continued.* PART V.

No pause.

TRACING No. 18—*Continued.* PART VI.



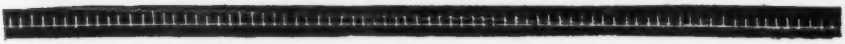
No pause.

TRACING No. 18—*Continued.* PART VII.

[Plate lost by maker of plates.—Showed no change except gradual fall of pressure.]

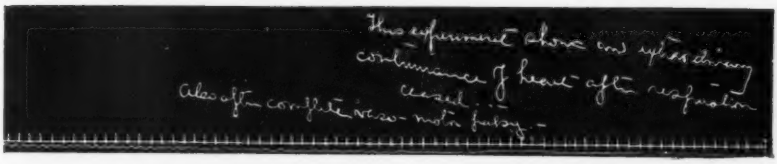
No pause.

TRACING No. 18—*Continued.* PART VIII.



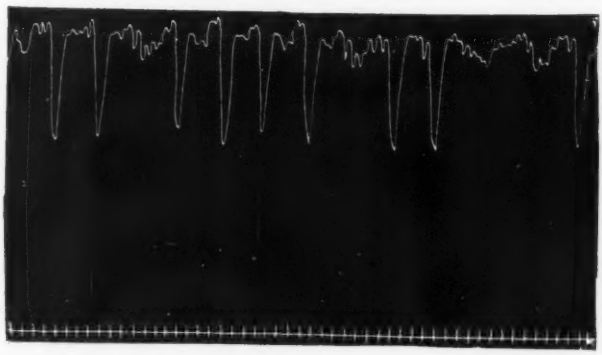
No pause.

TRACING No. 18—*Continued.* PART IX.



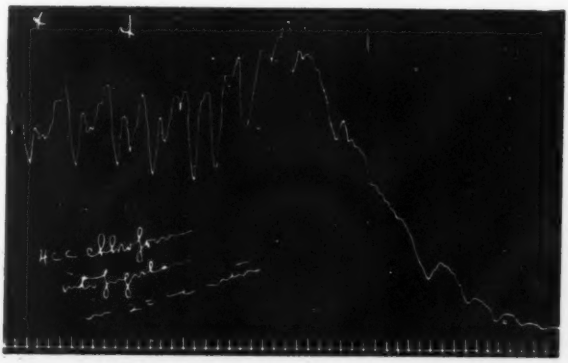
No pause.

TRACING No. 19. PART I.



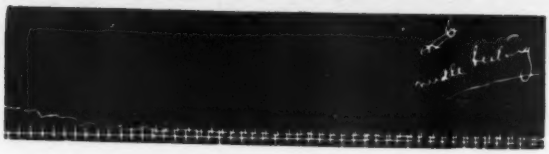
Dog, weight twelve kilos. This shows tracing before chloroform was used.

TRACING No. 19—*Continued.* PART II.



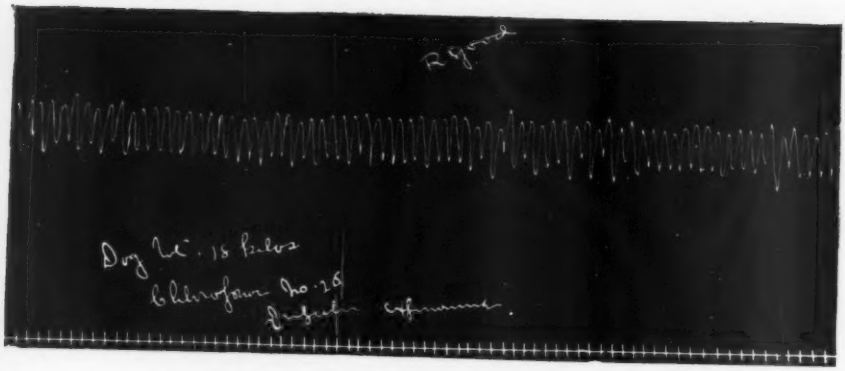
A pause of three minutes since last tracing to fix pen, which was out of order.

TRACING No. 19—*Continued.* PART III.

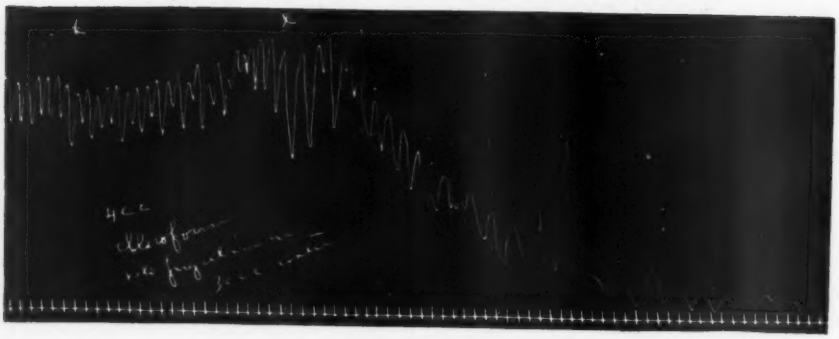


No pause.

TRACING No. 20. PART I.



TRACING No. 20—*Continued* PART II.

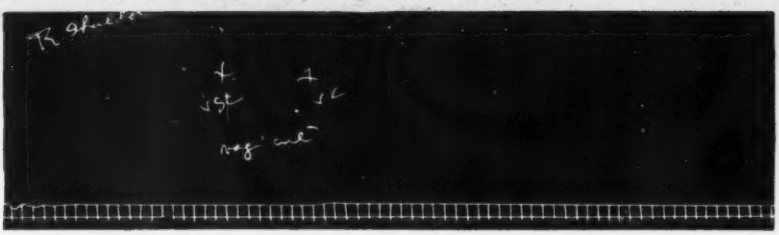


No pause.

TRACING No. 20—*Continued.* PART III.

No pause.

TRACING NO. 20—*Continued.* PART IV.

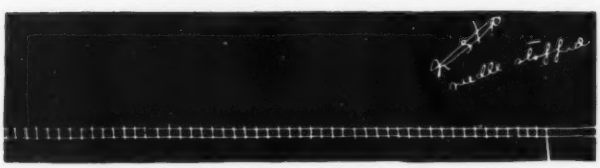


No pause.

TRACING NO. 20—*Continued.* PART V.

No pause.

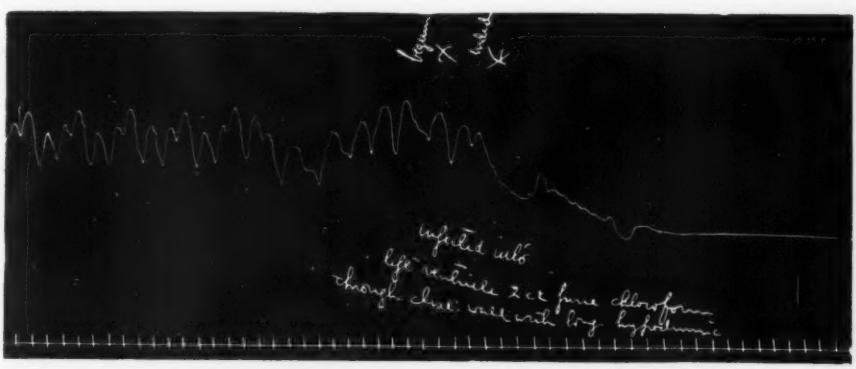
TRACING NO. 20—*Continued.* PART VI.



No pause.

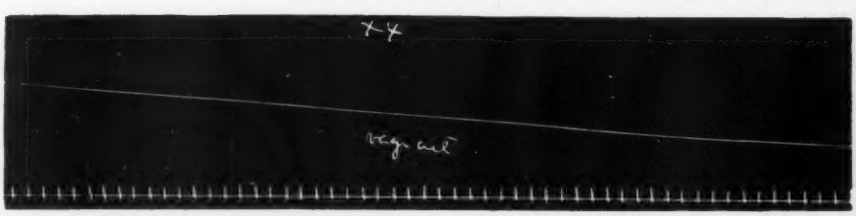
TRACING NO. 21. PART I.

This tracing shows arrest of heart by injecting chloroform into the left ventricle, and that the right continues to beat though the left stops. (See Part VII.)



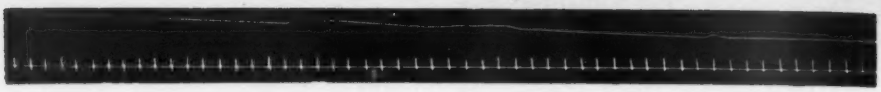
Dog, weight twelve and a half kilos.

TRACING NO. 21—*Continued.* PART II.



No pause.

TRACING NO. 21—*Continued.* PART III.



No pause.

TRACING NO. 21—*Continued.* PART IV.

No pause.

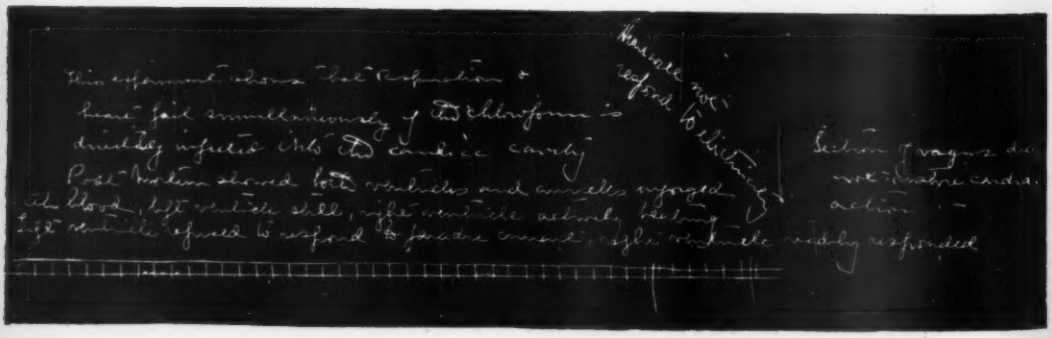
TRACING NO. 21—*Continued.* PART V.

No pause.

TRACING NO. 21—*Continued.* PART VI.

No pause.

TRACING NO. 21—*Continued.* PART VII.

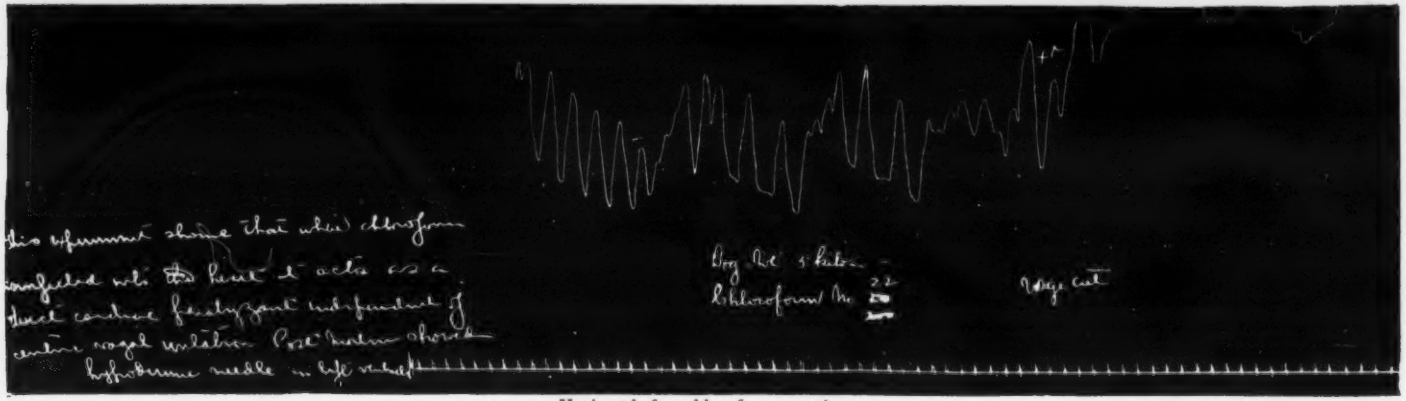

Reminder not responded to likewise
Section of vagus does not produce cardiac action
This experiment shows that respiration & heart fail simultaneously if the Chloroform is directly injected into the cardiac cavity
Post mortem showed both ventricles and auricles injected with blood, left ventricle still, right ventricle actual, beating
Left ventricle refused to respond to faradic current, right ventricle readily responded

No pause.

No pause.

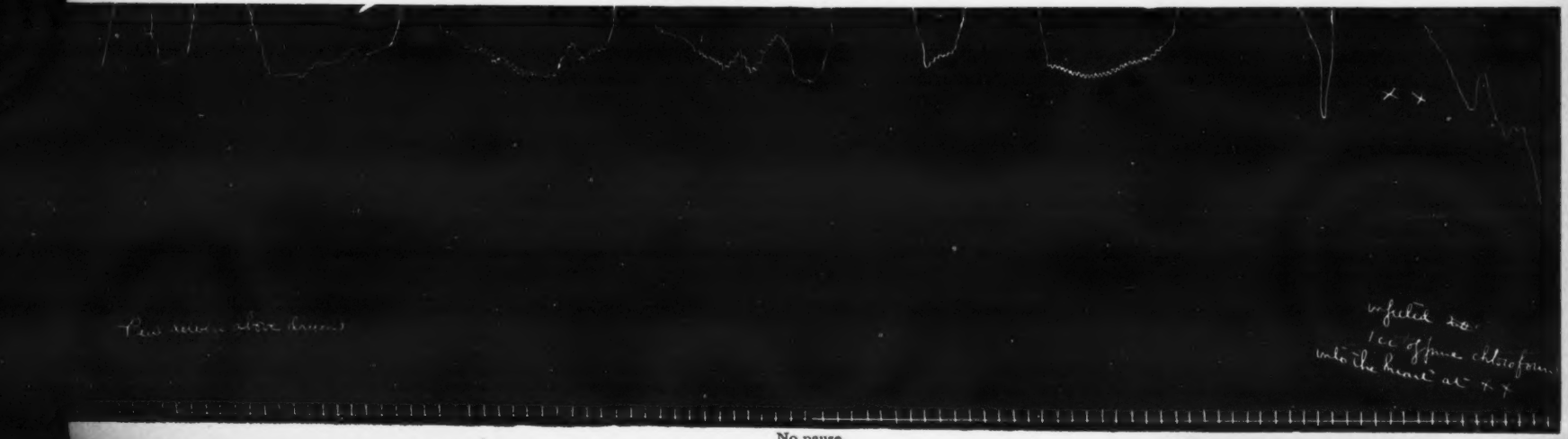
TRACING No. 22. PART I.

For explanation, read text and tracing, Part I.



Vagi cut before chloroform was given.

TRACING No. 22—*Continued.* PART II.

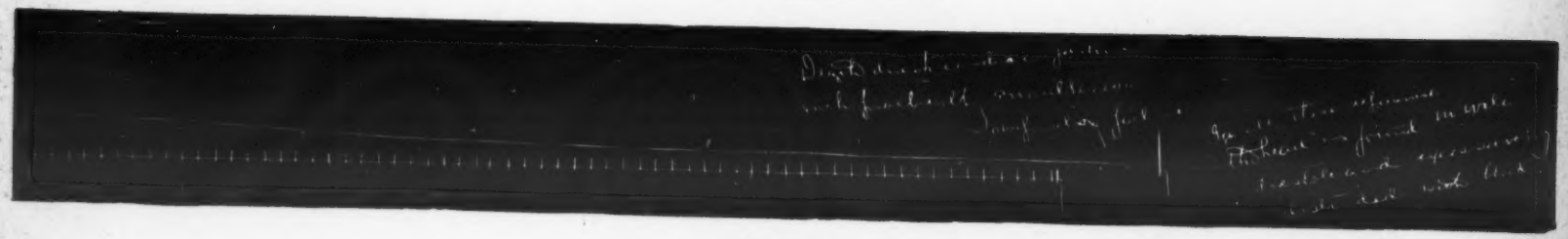


No pause.

TRACING No. 22—*Continued.* PART III.

No pause.

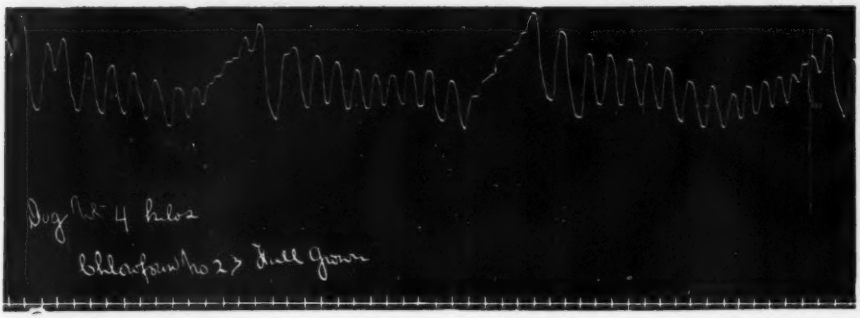
TRACING No. 22—*Continued.* PART IV.



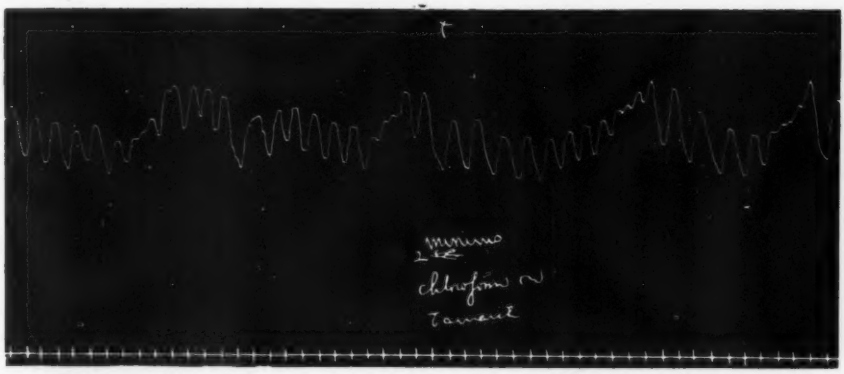
No pause.

TRACING No. 23. PART I.

This tracing shows how chloroform depresses the circulation, but that the pressure very soon rises as the animal frees itself from the drug. (See Part IX.) It also shows how, if chloroform is pushed, respiration ceases and the pressure falls. (See Parts XII., XIII., XIV., XV., and XVI.) See interesting rise of pressure in Parts XVII. and XVIII.

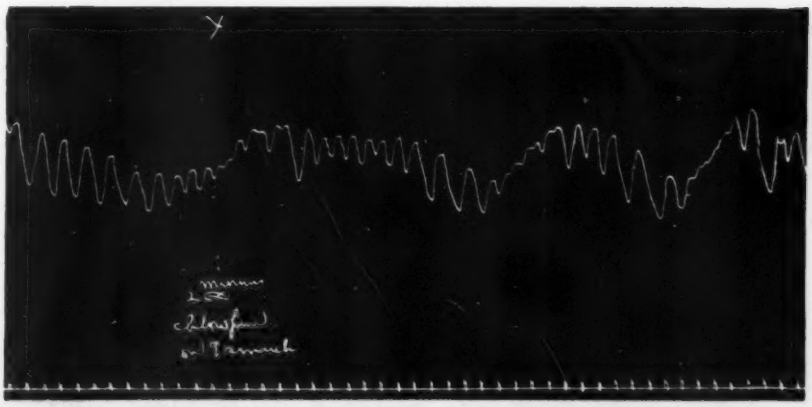


TRACING No. 23—*Continued.* PART II.



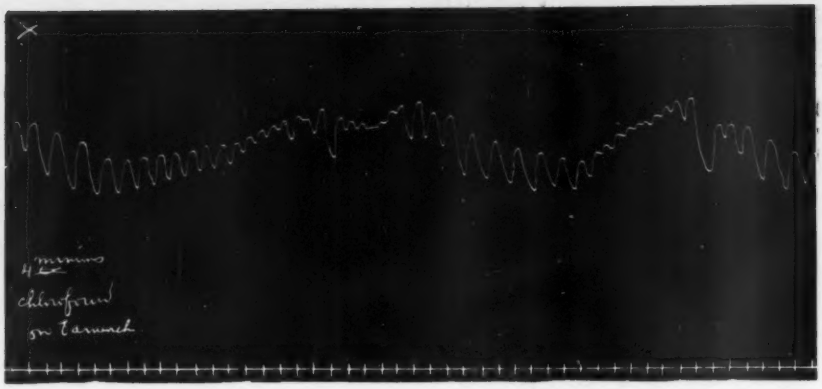
No pause.

TRACING No. 23—*Continued.* PART III.



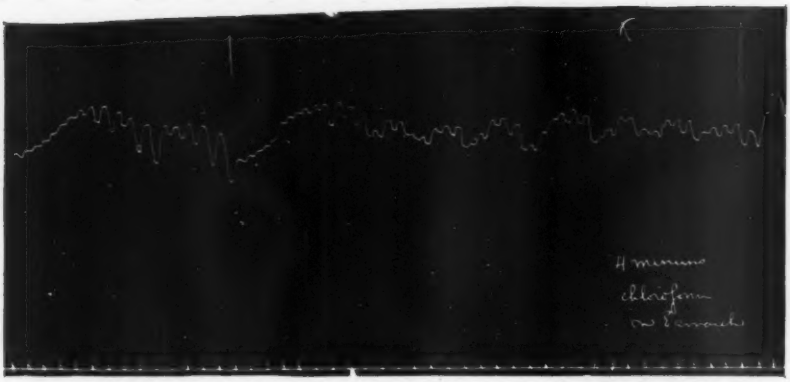
No pause.

TRACING NO. 23—*Continued.* PART IV.



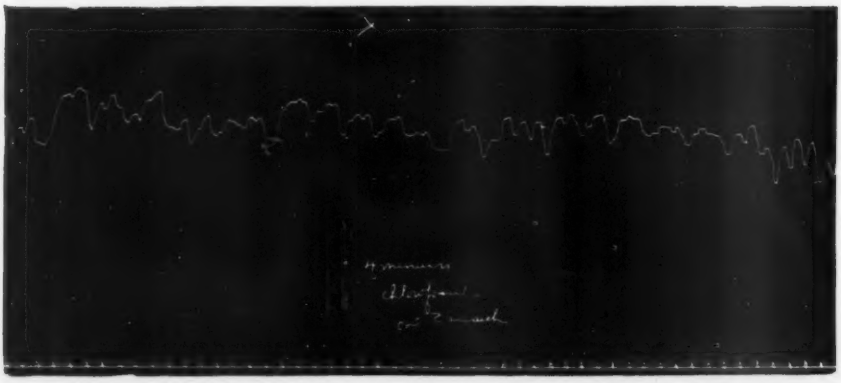
No pause.

TRACING NO. 23—*Continued.* PART V.



No pause.

TRACING NO. 23—*Continued.* PART VI.

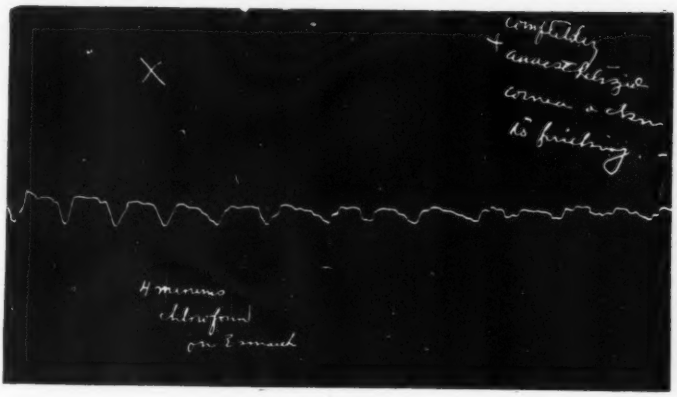


No pause.

TRACING No. 23—*Continued.* PART VII.

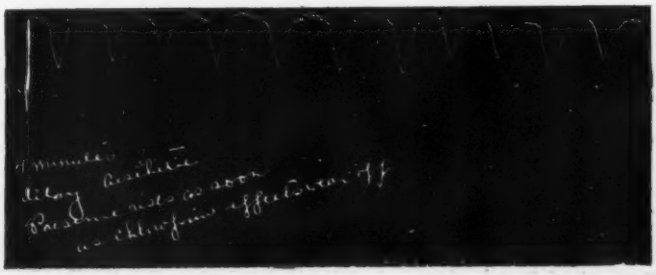
No pause.

TRACING No. 23—*Continued.* PART VIII.



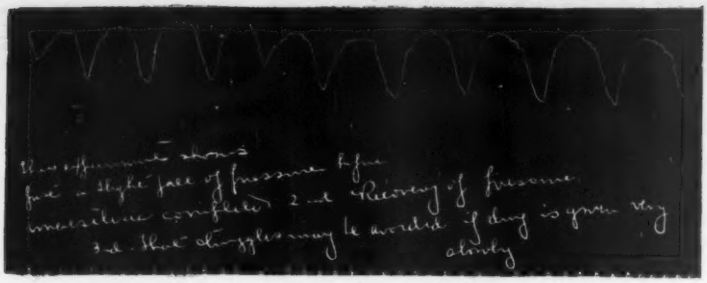
No pause.

TRACING No. 23—*Continued.* PART IX.



No pause.

TRACING No. 23—*Continued.* PART X.



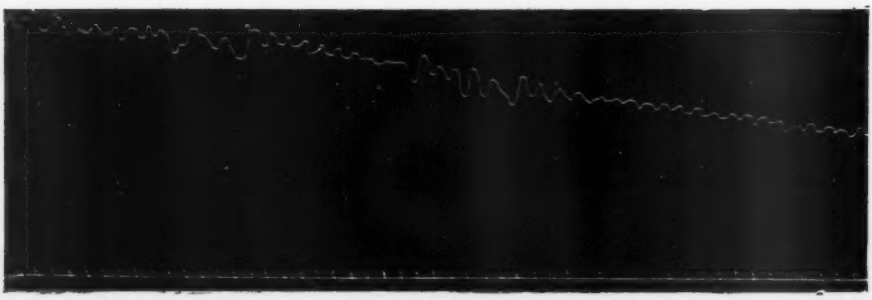
No pause.

TRACING No. 23—*Continued.* PART XI.

[Tracing lost by maker of plates.]

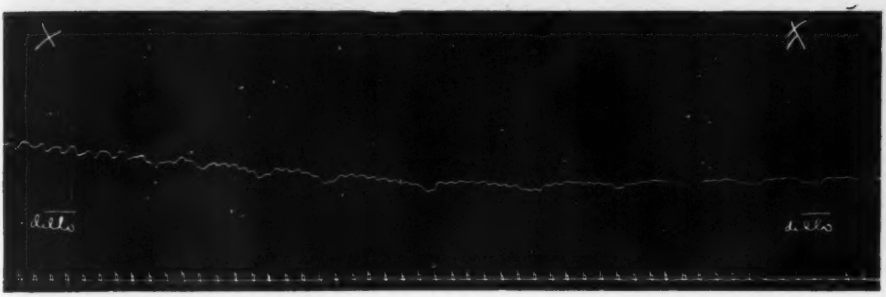
Chloroform given. Two minutes lost in changing drum.

TRACING No. 23—*Continued.* PART XII.



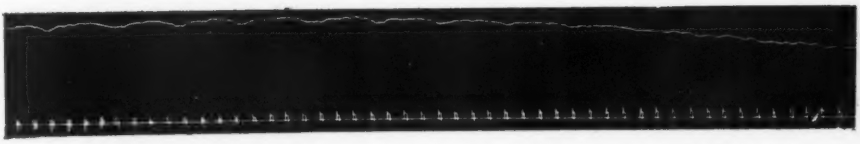
No pause.

TRACING No. 23—*Continued.* PART XIII.



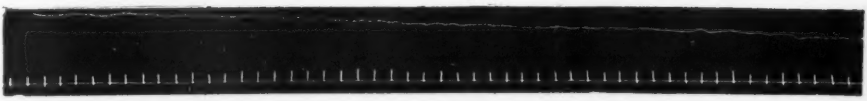
No pause.

TRACING No. 23—*Continued.* PART XIV.



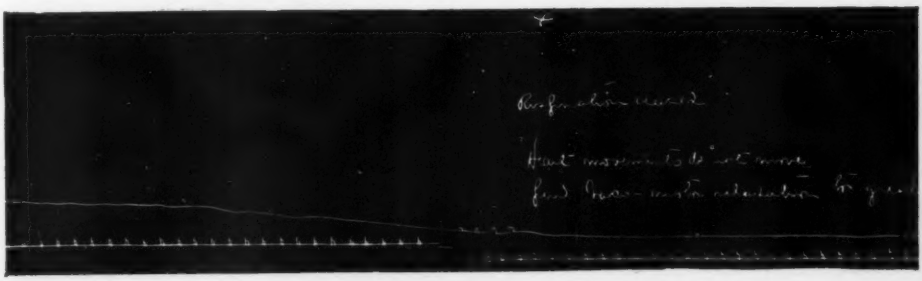
No pause.

TRACING No. 23—*Continued.* PART XV.



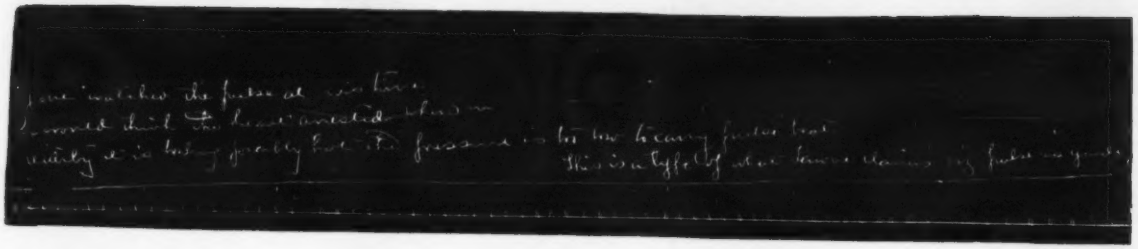
No pause. Heart maintains same pressure in vessels, though very feeble and apparently stopped so far as pulse work is concerned.

TRACING No. 23—*Continued.* PART XVI.



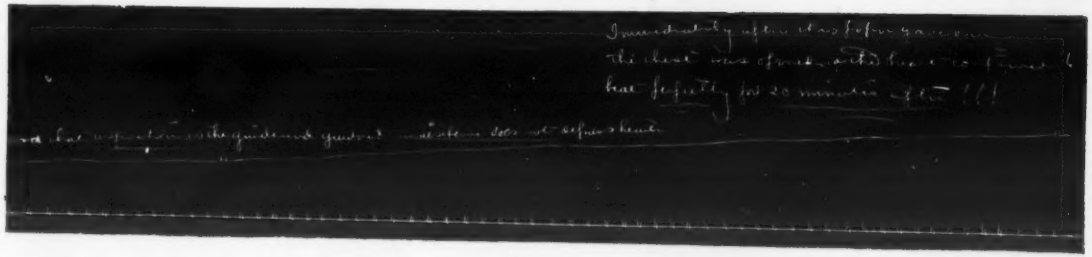
No pause. This shows the same as Part XV.

TRACING No. 23—*Continued.* PART XVII.



No pause.

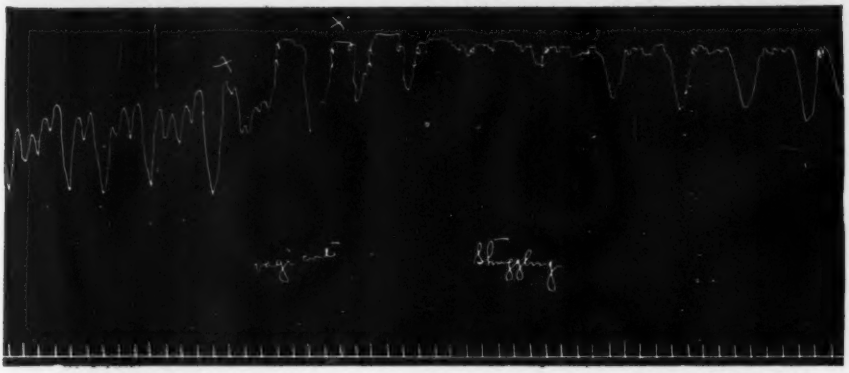
TRACING No. 23—*Continued.* PART XVIII.



No pause.

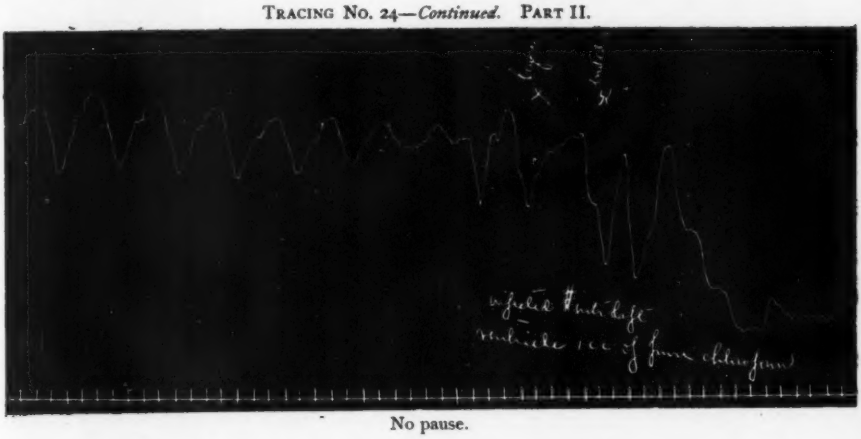
TRACING No. 24. PART I.

This tracing shows how chloroform, when in contact with the heart, acts as a direct depressing poison.



Dog, weight six and a half kilos. Full-grown bitch. No chloroform until after vagal section.

TRACING No. 24—*Continued.* PART II.

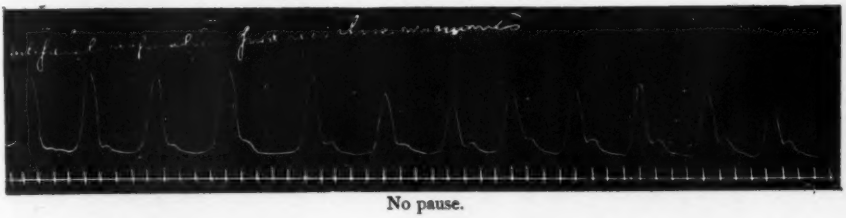


No pause.

TRACING No. 24—*Continued.* PART III.

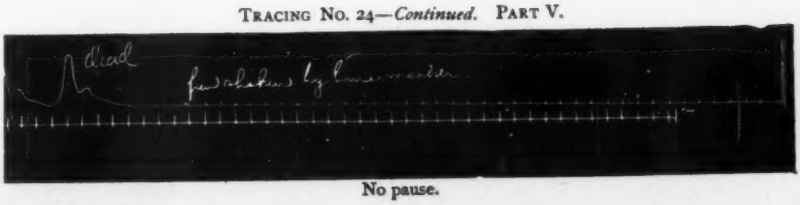
No pause.

TRACING No. 24—*Continued.* PART IV.



No pause.

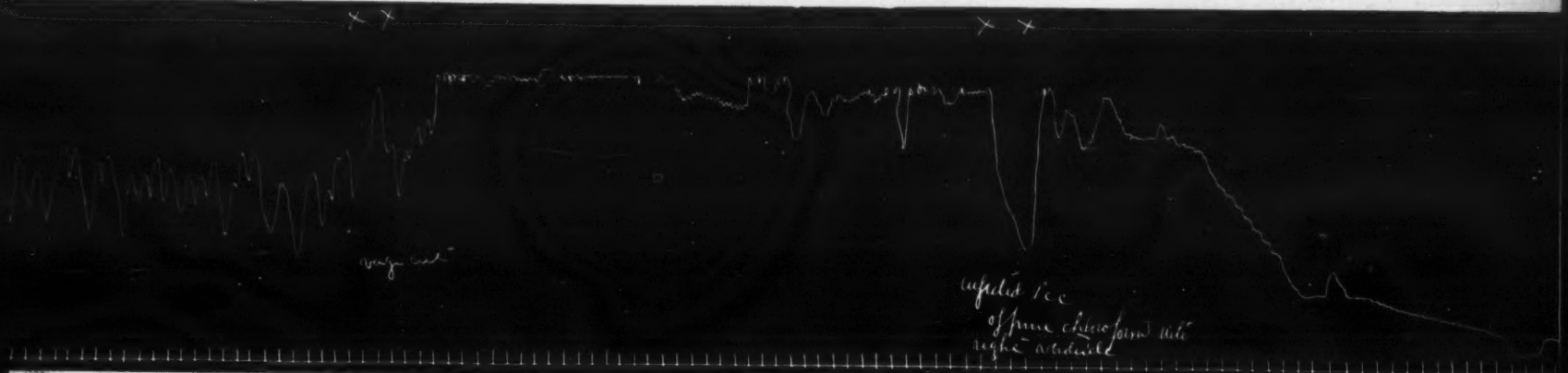
TRACING No. 24—*Continued.* PART V.



No pause.

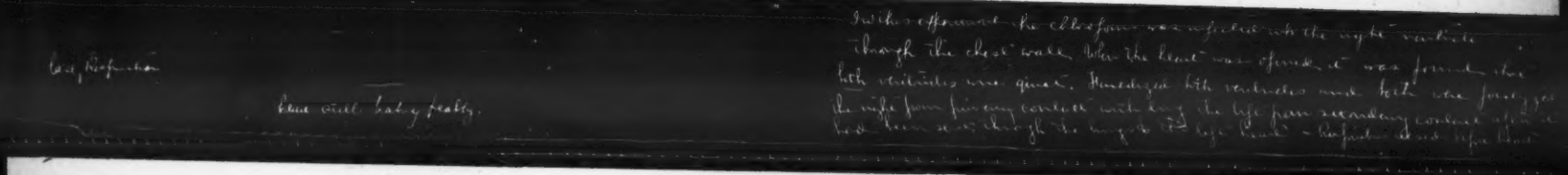
TRACING No. 25. PART I.

is tracing shows how chloroform paralyzes the heart-muscles when it comes in direct contact with it after injection into right ventricle. (See Part II.) Also, that the heart stops independently of any vagal action



Dog, weight eight and a half kilos. Vagi cut before chloroform used.

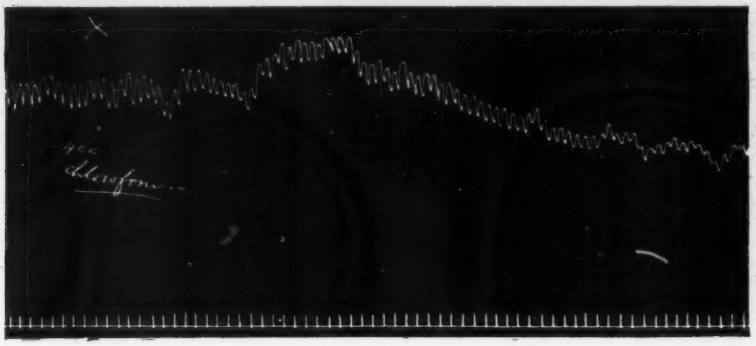
TRACING No. 25—*Continued*. PART II.



No pause.

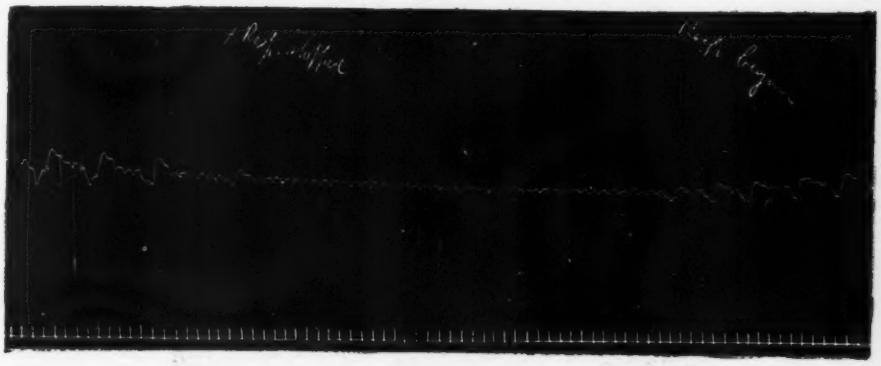
TRACING No. 26. PART I.

This tracing shows slight fall of pressure, stoppage of respiration, and spontaneous renewal of respiration.



Dog, weight twenty pounds. Four cubic centimetres of chloroform given on towel tightly applied to head.

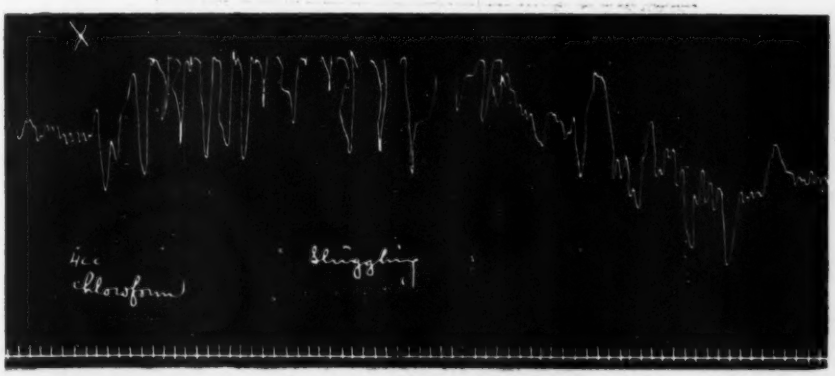
TRACING No. 26—*Continued.* PART II.



No pause.

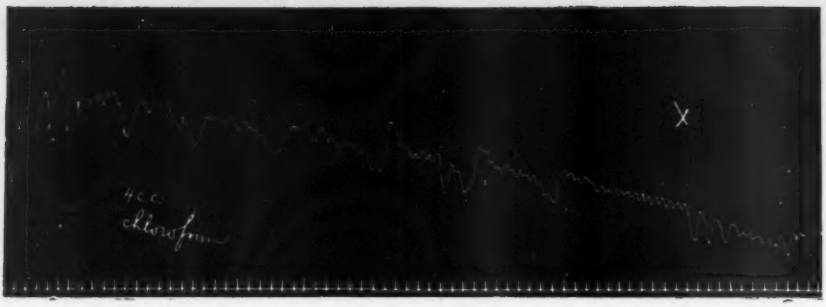
TRACING No. 27. PART I.

This tracing shows how artificial respiration, resorted to at the proper time, may result in recovery of respiration and circulation.



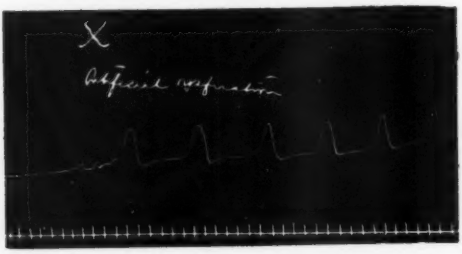
Dog, weight twenty kilos. Chloroform on towel tightly about head. Shows fall of blood-pressure. Arrest of respiration at × mark on next section of tracing.

TRACING No. 27—*Continued.* PART II.



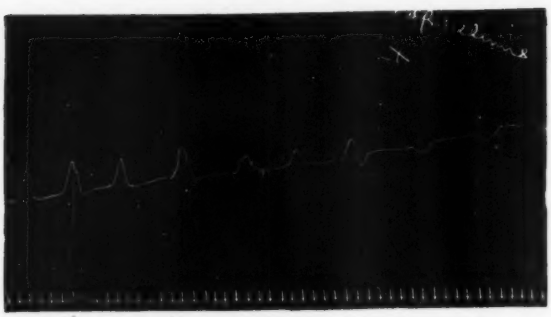
No pause. Respiration stopped at second × mark.

TRACING No. 27—*Continued.* PART III.



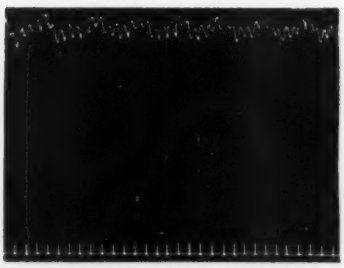
Ten seconds' pause.

TRACING No. 27—*Continued.* PART IV.



No pause.

TRACING No. 27—*Continued.* PART V.



Two minutes later.

ural respiratory curve. [We concur. (See our Experiments 3 and 27, Hare and Thornton.)] The difference consists chiefly in the fact that the artificial rise and fall is more abrupt than in normal breathing, and that the rise always coincides with expiration or compression of the chest. After artificial respiration has been continued for a certain time the blood-pressure begins to rise again, and a little later natural respiration returns. [We concur in this result.]

"24. The effect of artificial respiration in restoring an animal after the respiration had stopped was always marked. [See our Experiments 3 and 27 (Hare and Thornton). We therefore concur, as qualified by the next paragraph.] In a few exceptional cases, such as No. 159, a phosphorus dog, and No. 142, a horse which had an enormous overdose, although the artificial respiration was commenced as soon as possible after the breathing was noticed to have stopped, it was not successful.

"25. Complete stoppage of the respiration always means that an overdose has been administered, and the overdose may have been so great as to render restoration impossible. It is impossible to say whether, after chloroform has been pushed and then discontinued, the respiration will be restored spontaneously or not, and it is never in any case certain that artificial respiration will restore the natural respiration and blood-pressure, no matter how soon it is commenced after the respiration stops. [See our Experiments 1 and 5 (Hare and Thornton).] A great deal depends upon the amount of the after-fall: in some cases, even after the respiration has been restored, the pressure continues to fall and respiration again ceases, and artificial respiration then fails. We thus find respiration restored by artificial respiration while chloroform is still being absorbed, and this tends to show that artificial respiration does not merely pump the chloroform out of the blood, but exerts considerable influence in exciting the natural respiration.

"26. The time which elapses before artificial respiration succeeds in restoring natural respiration varies very greatly. In one case (No. 116) it was continued for eleven minutes before the first natural gasps commenced. This period is undoubtedly prolonged in some cases by a condition of physiological apnœa which renders it unnecessary for the animal to breathe. Consequently, whenever the pressure rose considerably during artificial respiration, it was stopped, and the animal then generally breathed after a few seconds. [Whenever apnœa developed, the fall of pressure would persist and a rise not take place (Hare and Thornton).]

"27. The time which may be allowed to pass with impunity before commencing artificial respiration also seems to vary considerably. This point was not particularly attended to in the manometer experiments 162 and 178, which were instituted to test the truth of the opinion formed by the sub-committee, that morphine had some slight action in impairing the efficiency of artificial respiration. In these cases the commencement of artificial respiration was postponed for more than two minutes after respiration ceased, and was successful; but this is certainly far above the average interval that can be allowed with safety. The success of artificial respiration in restoring the blood-pressure is, in some cases, very remarkable. In Experiment 40 the heart had apparently ceased beating, and the dog was believed by every one present to be dead, and yet recovered with artificial respiration. The success in this instance is due to the fact that concentrated chloroform had been pushed for two minutes, regardless of the breathing, and the stoppage of the heart was due to stimulation of the vagus through asphyxia. The animal was therefore easily restored, as he was suffering more from asphyxia than from chloroform-poisoning.

"28. It corresponds to those cases, which are so often reported, in which dangerous failure of the heart is said to have occurred some minutes after the administration of chloroform had been discontinued, and which are sometimes restored, and sometimes not, by artificial respiration. There is nothing at all sudden about the failure of the heart in these cases, but the attention of the chloroformist, which has been wandering, is suddenly called to the fact that the patient is apparently dead. When the animal was really dead, it was found in some cases that artificial respiration still maintained a small amount of mean pressure in the manometer. In others the pressure seemed to fall to the zero line between each compression of the chest. [We reach a similar conclusion.]

"29. The dangers of too vigorous artificial respiration were illustrated in some of the accidental deaths. In one case the liver was badly ruptured, and in another the pleural cavity was full of blood. In three cases (Nos. 80, 92, and 103) rhythmical movements of the diaphragm were noticed after the heart had ceased beating and after the chest had been opened. It is remarkable that in two of these cases the splanchnic nerve had been divided. The third

was a case in which chloroform had been injected into the jugular, and in this case there was a synchronous movement of the jaw as well. In all, death and stoppage of the heart had occurred gradually, and in No. 103 the heart was still irritable. These movements cannot be called respiration, though the last gasp of a dying animal—that ineffective jerk of the diaphragm which is such a fatal symptom—is very likely in many cases a movement of the same character. Similar movements, which were continued much longer, occurred in Experiment 104, after the thorax was opened, while the heart was still beating. Still more remarkable convulsions of the muscles of the jaws, ears, and forefeet occurred in Experiment 167, in the case of a dog that had been poisoned with nicotine. These movements continued at regular intervals for more than ten minutes after death, and were sufficiently forcible to jerk the handles of a pressure forceps fixed on the end of the tongue off the table at each spasm. In a rabbit in Experiment 153 the auricles of the heart continued to beat rhythmically for three hours after it was supposed to be dead from chloroform and its thorax had been laid open. Irritability of the heart after death was noticed in many cases, but seemed to be most marked in cases where ether had been used. [We have made no studies in regard to this point.]

"30. Chloroform injected into the heart through the jugular vein did not cause clotting of the blood, as was the case when ether was injected. [Chloroform did cause clotting in our experiments (Hare and Thornton).]

"31. In the course of the experiments of the committee various drugs were administered, in order to ascertain if they had any effect in modifying the action of chloroform. The result showed that none of them had any effect in preventing the typical descent of the blood-pressure that occurs when chloroform is inhaled. Atropine, when given in a dose sufficient to paralyze the vagi, of course prevents the action of those nerves in asphyxia, and, by increasing the action of the heart, it appears to cause a more rapid descent in the blood-pressure when chloroform is inhaled, as has been already explained. [We cannot agree to this. (See our Experiments 10, 16, 17, and 18, Hare and Thornton.)] Morphine appeared in Experiment 162 to render the rise in blood-pressure that occurred when the chloroform was discontinued slower and less complete and to bring about a more or less permanent condition of anæsthesia. It may be noted that the animal used in this experiment was a monkey, and in other experiments with monkeys, when no morphine had been given, it was remarked that the animal, after a few inhalations of chloroform, would often lie quite quiet, in a state of semi-sensibility, for a long time without further inhalations; still, this condition was much more marked in Experiment 162 than in any of the others. No action of this kind was noticed in the dog (Experiment 178); but other experiments (Nos. 90 and 94) showed that pariah dogs are very indifferent to the action of morphine, and it is probable that the dose of morphine in this case was insufficient to bring about the condition noted in the monkey. The peculiar behavior of the heart in Experiment 178 was not the result of the previous administration of morphine, for a similar phenomenon had occurred in other cases (49 and 60) in which no morphine had been given. Experiments 162 and 178 prove conclusively that morphine has no effect in shortening the period that may be allowed to elapse between the cessation of natural respiration and the commencement of artificial respiration. [We have already shown in Nos. 10, 16, 17, and 18 of our experiments that atropine seems to produce a very gradual fall of pressure and to preserve the circulation. With the other drugs we have not experimented (Hare and Thornton).]

"32. The other drugs used had no effect upon the action of chloroform, except when their own special action became the leading feature in the case, as, for instance, during the vomiting from apomorphine (Experiment 104, Fick, No. 9) or the convulsions produced by nicotine (Experiment 167).

"33. In order to test the alleged danger from shock during chloroform administration, the committee performed a very large number of those operations which are reputed to be particularly dangerous in this connection, such as extractions of teeth, evulsion of nails, section of the muscles of the eye, snipping of the skin of the anus, etc. In many cases the operation was performed when the animal was merely stupefied by the chloroform and not fully insensible. In such cases a slight variation in the blood-pressure would sometimes occur, such as one would expect from the irritation of a sensory nerve or from the struggling that ensued, but in no case in any stage of anæsthesia was there anything even suggestive of syncope or failure of the heart's action. In thrusting a needle into the heart there was often a momentary but well-marked fall of blood-pressure, but even this was absent in all other injuries. If chloroform really has any power to increase the tendency to shock in operation, it is im-

possible to believe that it would not have been manifested to some degree at least in one or other of these numerous experiments. The Commission was, however, not content with this negative result, and determined to ascertain the effect of direct irritation of the vagi during continued chloroform administration. The result of such experiments (Nos. 65, 117, and others) proved that inhibition of the heart's action prevented rather than assisted the fatal effects of prolonged chloroform inhalation. An animal that was put into a condition of extreme danger (from which it could only be restored by means of artificial respiration) by inhalation of chloroform for one minute, recovered spontaneously and readily after five minutes of chloroform, together with inhibition of the heart, by electrical irritation of the vagus carried on simultaneously. In one of these experiments (No. 117) chloroform was pushed for seven minutes; and during continued irritation of the vagus the animals repeatedly came round without artificial respiration. The danger really begins when the irritation is discontinued or fails to inhibit the heart, and thus enables the chloroform in the lungs to be rapidly absorbed and thrown into the blood by means of artificial respiration; for animals in which this was done, although they showed a tendency to recover when the chloroform and irritation of the vagus were discontinued, afterwards died rapidly.

"34. On another occasion, during Experiment 117, the animal was very nearly killed by a comparatively short inhalation of chloroform, owing to the electrodes becoming accidentally short-circuited and failing to keep up the irritation of the vagus. Something similar occurred in Experiment 177, the effect of the irritation of the vagus passing off while the chloroform was still being pushed, and thus putting the animal into a condition of extreme and unexpected jeopardy. Nothing could be more striking than these near approaches to accidental death from failure to irritate the vagus efficiently.

"35. Other experiments were made to test the truth of the statement that chloroform increases the action of electrical stimuli applied to the vagus, and showed conclusively that it has no such effect. In one instance only the inhibition seemed to be intensified as the chloroform was commenced and diminished when it was discontinued; but apart from the fact that the supposed effect ceased much too suddenly, a repetition of the experiment on the same and other animals showed that there was in reality no such effect. The increased inhibition in this instance was due to the chloroformist compelling the attendant who was holding the electrodes to change his position, and thus making him unconsciously apply them more efficiently. When the chloroformist withdrew they were restored to their former position. This affords an instance of the care that has to be taken in making experiments if one is not to be deceived.

"36. To test the effect of shock due to vasomotor change rather than affection of the heart, Goltz's experiment on the frog was repeated on three dogs. In one there was slight lowering of pressure, which was not extensive, but in the others no effect was produced at all. Other operations which seemed likely to produce shock, such as violent blows upon the testicle, were singularly devoid of effect. Failing to lower the blood-pressure by any of these methods, recourse was had to section of the splanchnics, but the low condition of blood-pressure this produced appeared, like stoppage of the heart from vagus irritation, to be a source of safety rather than of danger during chloroform administration. In this connection Experiment 111 may be studied. There was not much external hemorrhage, but the splanchnics were divided,—a proceeding which, as is often said, bleeds the animal into his own vessels. The pressure was after this extremely low, but chloroform was repeatedly given and various other actions taken, and then chloroform had to be pushed on a saturated sponge inclosed in a cap for eleven minutes before respiration ceased.

"37. The experiments on dogs that had been dosed with phosphorus for a few days previously show that the fatty, and consequently feeble, condition of the heart and other organs so produced has no effect in modifying the action of chloroform. The ease with which vagus irritation and the Glasgow trace could be produced in these animals, by even slight degrees of asphyxia (*vide* Experiment 148), was very remarkable; but this was equally the case in dogs that had been given phosphorus only a few hours before the experiment, and whose organs were not yet fatty (*vide* Experiment 156). Many of these cases were in the last stage of phosphorus-poisoning, and several of their companions died without any experiment having been performed on them, before or on the same day as they did (*vide* the low state of blood-pressure in Experiment 163). [We have no experience to offer (Hare and Thornton).] Numerous attempts were made in these animals to produce shock by operations in the recumbent and vertical positions, but with-

out any result more than in those that were healthy.

"38. The truth about the fatty heart appears to be that chloroform *per se* in no way endangers such a heart; but, on the contrary, by lowering the blood-pressure, lessens the work that the heart has to perform, which is a positive advantage. But the mere inhalation of chloroform is only a part of the process of the administration in practice. A patient with an extremely fatty heart may die from the mere exertion of getting upon the operating-table, just as he may die in mounting the steps in front of his own hall-door, or from fright at the mere idea of having chloroform or of undergoing an operation, or during his involuntary struggles. Such patients must inevitably die occasionally during chloroform administration, and would do so even were attar of roses or any other harmless vapor substituted for chloroform."

[We agree entirely with this statement; but as chloroform has confessedly some cardiac action and a very positive vaso-motor and respiratory effect, the fatal result might be more direct.]

SUMMARY.

Having given the evidence we have accumulated, let us see what practical deductions may be drawn.

From a careful study of the experiments so far reported, from studies made by one of us some two years ago with H. C. Wood, and, finally, from the careful series of experiments (the tracings of which we herewith append), we believe that the question can be settled by the acceptance of both views in a modified form, or, in other words, that there is no real antagonism in the beliefs that chloroform kills by depression of the heart or depression of the respiration.

We very positively assert that chloroform practically always kills by failure of respiration when administered by inhalation, provided—and this provision is most important—that the heart of the anæsthetized is healthy and has not been rendered functionally incompetent by fright or violent struggles, or, again, by marked asphyxia. By a healthy heart we mean one which has not undergone true fatty degeneration, or has not so severe a valvular lesion as to make the slightest variation in the even tenor of the circulation fatal.

As positively as we assert that chloroform kills primarily by respiratory failure, so do we also assert that in excessive dose by inhalation it has a depressant effect on the circulation, which is chiefly due to centric vaso-motor depression, with final depression of the cardiac muscle itself. Depression of the cardiac muscle alone is never great enough to cause death when the chloroform is given by inhalation, but we believe that gradual asphyxia, with the direct depression of the circulation, may do much towards producing a fatal result, for vaso-motor integrity is almost as necessary to life as an intact cardiac mechanism. This circulatory depression has been considered a safeguard because it was supposed to prevent chloroform going to the vital centres; but in reality it is no safeguard, because profound circulatory depression is as great an evil as respiratory narcosis. That the circulatory depression may be dangerous is not only evident, but it is stated to be so by the second Hyderabad Commission itself at the end of paragraph 8. This circulatory depression may be so profound that recovery is impossible even with the most thorough artificial respiration, a fact stated by the second Hyderabad Commission in paragraph 25, which we quote in this paper. This emphasizes the fact that we cannot afford to totally ignore the effect of chloroform on the circulation, and we cannot consider the patient in danger of circulatory failure *only* when the respiration *ceases*, BUT AS SOON AS IT BECOMES ABNORMAL. On the other hand, we should remember that, even if chloroform has been given properly, the arterial pressure may be so low as to give no pulse in the radial artery, and yet the circulatory system be ready to respond at once when the drug is removed. If, therefore, the chloroform is properly administered, is there danger of its circulatory effect in man? We think that it is just at this point that our research, and every other research on animals, fails, and necessarily fails, to produce a positive reply. The variation in the action of a drug on a diseased individual from its effect on the normal one is notorious, and we have no right to dogmatically assert that there is absolutely no danger of circulatory depression in man, even if we found no evidence of failure in dogs, because there may be many idiosyncrasies or variations, through disease in the human being, which may completely reverse the results of experiments on healthy animals.

In other words, supposing that the amount of depression from very full doses of chloroform equals 25 units, this amounts to little in the normal heart; but if the heart be depressed 25 additional units by disease, the depression of 50 units may be fatal, particularly if to this 50 is added 25 units more of depression through fright and cardiac engorgement, through disordered respiration or struggling. That true

depression of the heart-muscle may take place under chloroform seems to us most undoubted, and we think that the tracings in every research that we have seen support this view. There is always a decrease in cardiac power manifested by the decrease in the force of the individual pulse-beat, and this passes away only if chloroform is removed early enough. We also agree with McWilliams that from the very first inhalation of chloroform there is a constant tendency to cardiac dilatation.

We come, finally, to the all-important questions:

1. Is chloroform a safe anæsthetic?

2. Are we to watch the pulse or respiration during the use of the drug, and what are the signs in the respiratory function indicative of danger to the patient?

3. What is the true cause of death from chloroform?

4. Is death from chloroform possible when it is properly administered?

5. Under what circumstances is the surgeon to use chloroform in preference to the less dangerous anæsthetic ether?

6. What is the best way of administering chloroform?

To the first question the answer is, Yes, for the majority of cases, provided it is given by one who is skilled in its use, and not only knows how to give it, but to detect signs of danger. It is not so safe as ether at any time, other things being equal, and never so safe in the hands of a cyno.

To the second question the answer is, Watch the respiration, because as soon as enough chloroform is used to endanger the circulation, the respiration will show some signs of abnormality, either in depth, shallowness, or irregularity. In other words, the very effect of the drug may be to cause such deep and rapid respirations that an excessive quantity of the drug is taken into the lungs and continues to be absorbed even after the inhaler is withdrawn.

As there is always a fall in pressure under chloroform, it is difficult to feel the radial or temporal pulse, and the respiratory centre recognizes the degree of arterial depression which its sister vaso-motor centre has permitted by finding that its blood-supply is insufficient. As respiration fails first, it should be watched first. Finally, it is only by watching the respiration that we can tell how much chloroform the patient is getting. We do not watch this function for danger alone, but to tell us of the dose.

The answer to Question 3 is that death is always due in the healthy animal to respiratory failure accompanied by circulatory depression, which latter may be severe enough to cause death, even if artificial respiration is used skilfully. Death only occurs in the healthy animal when chloroform is given in excessive quantities.

Question 4 is impossible to answer for man from the basis of experimentation, as we cannot produce identical diseased states in animals with those developed under various conditions in man. The physician having a case of heart-disease should always advise the patient of the danger of any anæsthetic, and he should remember, whether it is wise to tell the patient or not, that anæsthesia always means a step towards death, even in the healthiest of men. In the event of a death under chloroform, the physician is not to blame if he has taken proper preliminary precautions and given the chloroform properly.

Every one is agreed that the patient taking chloroform should have plenty of fresh air, and in India we understand that, to all intents and purposes, patients are operated on in the open air, at least as compared to the closed rooms necessary in America and Europe. This free supply of air is important, whether we believe death to be imminent from cardiac or respiratory failure; but this supply of air matters little to the patient if he does not breathe freely, nor does the dose of chloroform amount to aught if it is not drawn into the chest. The dose of chloroform is not the amount on the inhaler, but the amount taken into the chest, and, finally, the amount absorbed by the blood-vessels. The rapidity and depth of respiratory movements is, therefore, as Lawrie asserts, the entire key to the situation. We watch a windmill over a well to see if it is pumping into a reservoir a given quantity of water. If the windmill works irregularly, so that we know its pumping action is deranged, we separate it from the pump until it works steadily. Similarly we withdraw chloroform, as Lawrie says, whenever respiration becomes disturbed in rhythm or when struggling disturbs it, because it is the first indication that the drug's action is uncertain, and because there is no telling the dose which is absorbed. While watching the respiration will not warn us of a sudden cardiac arrest in fatty heart plus chloroform depression, neither will the pulse give us such warning, and we are confident that the statement of the Hyderabad Commission, that the *respiration should be watched*, is correct, for we believe, from a long series of observations, that gradual cardiac failure never occurs without producing respiratory changes from the

very first. In other words, we do not believe that in a *healthy* heart chloroform can cause serious disorder without, as a result of beginning disorder, disturbing respiration; and, second, that in a healthy heart a quantity of chloroform sufficient to disorder it will by its direct action disorder the respiration. If, as an extra precaution, one assistant watches the pulse while the other watches the respiration, very well, for though the respiration is the more important function to watch, the man watching the pulse might discover an irregularity which the anæsthetizer may not see reproduced in the respiratory action; but as divided attention generally means a slighting of both objects in view, Lawrie is right in insisting on the pulse being let alone.

In answer to Question 5 we have several points to offer:

1. Hot climates (where ether is inapplicable), where a free circulation of air increases the safety of the patient.

2. Chloroform may be used whenever a large number of persons are to be rapidly anæsthetized, so that the surgeon may pass on to others and save a majority of lives, even if the drug endangers a few, as on the battle-field, where only a small bulk of anæsthetics can be carried.

3. Its employment is indicated in cases of Bright's disease requiring the surgeon's attention, owing to the fact that anæsthesia may be obtained with so little chloroform that the kidneys are not irritated, whereas ether, because of the large quantity necessarily used, would irritate these organs. Quantity for quantity, ether is, of course, the less irritant of the two.

4. In cases of aneurism, or great atheroma of the blood-vessels, where the shock of an operation without anæsthesia would be a greater danger than the use of an anæsthetic, chloroform is to be employed, since the greater struggles caused by ether and the stimulating effect which it has on the circulation and blood-pressure might cause vascular rupture.

5. In children or adults who already have bronchitis, or who are known to bear ether badly, or, in other words, have an idiosyncrasy to that drug, chloroform may be employed.

6. Persons who struggle violently, and who are robust and strong, are in greater danger from the use of chloroform than the sickly and weak, probably because the struggles strain the heart and tend to dilate its walls.

The safest method of administration is by Lawrie's or Esmarch's inhaler, because these provide free circulation of air and do not distract the attention of the anæsthetizer from the respiratory movement by complicated apparatus. Apparatus much like these, in allowing a free amount of air, are the Hyderabad chloroform inhaler or open-ended cone, with Krohne's and Seseman's respiration indicator attachment.

The Junker inhaler, even with its modifications, is too complicated and cumbersome, and while less chloroform is wasted in administering the drug, it must all be thrown out of the bottle afterwards. If used at all, it should be used with the increased air-supply and respiration indicator of Krohne and Seseman.

We agree so heartily with Lawrie's personal conclusions that we print them below:

1. The chloroform should be given on absorbent cotton, stitched in an open cone or cap. (A depression made through the opening in the inside flannel bag will answer as well.)

2. To insure regular breathing, the patient, lying down, with everything loose about the neck, heart, and abdomen, should be made to blow into the cone, held at a little distance from the face. The right distance throughout the inhalation is the nearest which does not cause struggling or choking or holding of the breath. Provided no choking or holding of the breath occurs, the cap should gradually be brought nearer to, and eventually may be held close over, the mouth and nose as insensibility deepens.

3. The administrator's sole object while producing anæsthesia is to keep the breathing regular. As long as the breathing is regular, and the patient is not compelled to gasp in chloroform at an abnormal rate, there is absolutely no danger whatever in pushing the anæsthetic till full anæsthesia is produced.

4. Irregularity of the breathing is generally caused by insufficient air, which makes the patient struggle or choke or hold his breath. There is little or no tendency to either of these untoward events if sufficient air is given with the chloroform. If they do occur, the cap must be removed, and the patient must be allowed to take a breath of fresh air before the administration is proceeded with.

5. Full anæsthesia is estimated by insensitiveness of the cornea. It is also indicated by stertorous breathing or by complete relaxation of the muscles. Directly the cornea becomes insensitive or the breathing becomes stertorous, the inhalation should be stopped. The breathing may become stertorous while the cornea is still sensitive. The rule to stop the inhalation should, notwithstanding, be rigidly enforced,

and it will be found that the cornea always becomes insensitive within a few seconds afterwards.

It is only necessary to add that the patient should be so dressed for an operation that his respiratory movements can be easily seen by the chloroformist. In the climate of India this is not difficult to manage, but it is rather more so in the climate of Europe; so that in this respect, and in this respect alone, the chloroformist in England is placed at a distinct disadvantage compared with the chloroformist in India.

NOTE.—Since writing this report two important papers upon this subject have appeared in the London *Lancet*,—the one by Gaskell and Shore, in which they carried out a complete line of ingenious cross-circulation experiments, and from which they conclude that the fall in blood-pressure seen under chloroform is due to cardiac rather than vaso-motor depression; and another paper, published by Lawrie, in the London *Lancet* for February 11, 1893, in which he refutes the statements made by Gaskell and Shore, and details experiments which he believes combat those of the two investigators just named.

We cannot help believing that cross-circulation experiments in regard to the action of chloroform must be received with considerable doubt by the practising physician. Even if such work is carried out with the greatest skill, the opportunities for error are innumerable; and while results are obtained which, if in accord with other studies, might be accepted as confirmatory, the fact that they differ makes their negative conclusion of little value.

The object of the investigator of the action of chloroform is to perform experiments which, so far as possible, will be counterparts of the employment of the drug for human beings.

To the physiologist it is important to study a drug in order that certain results may be obtained, whether they have practical bearing or not; but the practising physician only wishes those points which should guide him in the administration of the remedy.

The concluding paragraph of Lawrie's latest contribution to the subject states the facts so clearly, and is so in accord with what we have tried to set forth in our own report, that we cannot do better than quote the paragraph:

"The Hyderabad Commission's work proves that, while Syme's principles are right, there is no such thing as a safe method of chloroform administration. It is no longer a question of the superiority of the London method or of the Edinburgh method; absolute safety can be attained neither by watching the respiration nor the pulse for signs of danger, which are in either case proof of improper administration or of overdosing. Moreover, overdosing may take place whether the anæsthetic is given on lint or on a towel or on a cap such as we use, or with Junker's or Skinner's or any other form of apparatus. The all-important point is that the breathing shall never be interfered with in any way. Safety under chloroform can unquestionably be insured, but it can only be so by attending to regular natural breathing; and whatever method is employed, no one can deny that it is the bounden duty of the chloroformist to maintain natural breathing throughout the whole period of administration. To maintain natural breathing requires careful training and considerable experience; but if these conditions be fulfilled it is impossible to produce anything with chloroform but anæsthesia, and the Hyderabad Commission has shown that anæsthesia alone is entirely free from risk."*

In reply to a general request for reports of cases of accident under chloroform, we received the answers shown in the appended table, which may be summarized as follows:

Number of respiratory failures.....	29
Number reported unable to feel pulse, while respiration continued.....	4
Number of simultaneous failures.....	1
Number not stated.....	1
Total number of accidents reported...	35

Of the 29 respiratory failures there were 5 deaths, a percentage of 17¼. Of the 4 circulatory failures there were 2 deaths, a percentage of 50. The 1 case of arrest of respiration and circulation simultaneously resulted in death.

This summary is particularly interesting in that the great majority of accidents were due to respiratory failure and not to the heart, and this failure was irrespective of age, sex, condition, or magnitude of operation; also that the accident may occur before, during, or after the operation; and, finally, that in some instances circulatory failure takes place while respiration continues.

* Provided the patient is in ordinary health. We would prefer to make the last sentence read, "Anæsthesia can be safely produced by chloroform." (Hare and Thornton.)

Report of Accidents occurring during the Use of

Name of reporter.	Age.	Sex.	Operation.	State of patient at time of beginning anæsthetic.	Kind of chloroform administered.	Anæsthetist.	How administered.	Rapidity of administration.	Concentration of vapor.	Length of time chloroform had been administered at time of accident.
.....	21 yrs.	Male.	Oblique inguinal hernia.	Patient calm.	Squibb's C. P. chloroform.	Skilled.	On towel.	Few drops at a time.	Plenty of air.	5 minutes.
A. M. Haydem, Evansville, Ind.	67 yrs.	Male.	Epithelioma of upper lip.	Patient calm.	Chloroform.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
H. S. Harrington, Bertrand, Neb.	8 mos.	Male.	Talipes varus.	Not stated.	U. S. P. chloroform.	Skilled.	Not stated.	Not stated.	Not stated.	Not stated.
T. F. Hallett, Rose, N. Y.	6 yrs.	Male.	Amputation of cut finger.	Not stated.	Quality of chloroform not stated.	Skilled.	Not stated.	Not stated.	Not stated.	Not stated.
W. H. Washburn, Milwaukee, Wis.	45 yrs.	Male.	Renal colic.	Not stated.	Squibb's C. P. chloroform.	Skilled.	On handkerchief.	Few drops at a time.	Plenty of air.	Not stated.
M. P. Murin, Denver, Col.	9 yrs.	Male.	Tenotomy of tendo Achillis and plantar fascia.	Not stated.	Not stated.	Unskilled intern.	Not stated.	Pushed as if it were ether.	Concentrated vapor of chloroform.	Operation half over; time not stated.
M. P. Murin, Denver, Col.	22 yrs.	Male.	Tight stricture; internal urethrotomy.	Patient calm.	Pure chloroform.	Not stated.	Not stated.	Not stated.	Not stated.	Operation over; exact time it had been administered not stated.
M. P. Murin, Denver, Col.	45 yrs.	Male.	Stricture.	Took drug badly.	Not stated,	Not stated.	Not stated.	Not stated.	Not stated.	Operation not begun; time not stated.
E. Lamphear, Kansas City.	Not stated.	Not stated.	Cancer of pancreas.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
A. W. Wilmarth, Norristown, Pa.	16 yrs.	Female.	Epileptic convulsions.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
C. T. Southworth, Monroe, Mich.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
C. T. Southworth, Monroe, Mich.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Skilled.	Esmarch inhaler.	Few drops at a time.	Plenty of air.	Operation nearly over; exact time not stated.
C. D. Wescott.	16 yrs.	Male.	Sarcoma.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
No. 1.	3 yrs.	Female.	Harelip, cleft palate.	Not stated.	.....	.....	.....	.....	.....	.....
J. H. Kellogg, Battle Creek, Mich.	24 yrs.	Male.	Left inguinal hernia.	Quiet.	Chloroform supposedly pure.	Not stated.	Junker inhaler.	Given carefully.	Not stated.	Late; operation almost completed.
L. Reynolds, Horton, Kan.	28 yrs.	Male.	Enteralgia.	Quiet.	Squibb's C. P. chloroform.	Not stated.	Handkerchief.	Patient pulled drug over face and mouth.	Not stated.	After a few moments.
.....	5 yrs.	Male.	Crushed finger.	Not stated.	Not stated.	Unskilled.	Not stated.	Given carefully.	Not stated.	Early in administration.
H. Mallens Watson, Norfolk, S. D.	2 yrs.	Male.	Removal of cancerous tentacle.	Not stated.	Not stated.	Not stated.	Not stated.	Given carefully.	Not stated.	5 minutes.
Robt. T. Morris, New York.	4 yrs.	Male.	Club-foot.	Took drug well up to time of full anæsthesia.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	.....
Robt. T. Morris, New York.	30 yrs.	Female.	Dilatation of cervix.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Before operation; time not stated.
Robt. T. Morris, New York.	35 yrs.	Female.	Straightening a flexed uterus.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
J. T. Webster, Emporia, Kan.	4 yrs.	Male.	Paraphimosis.	Not stated.	Not stated.	Unskilled.	On cloth.	Not stated.	Not stated.	Not stated.
J. T. Webster, Emporia, Kan.	Not stated.	Male.	Amputation of the thumb.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
J. N. Coons, Palmyra, Mo.	Young adult.	Male.	Removal of necrosed sequestrum of tibia.	Very weak and exhausted.	Not stated.	Skilled.	Not stated.	Not stated.	Well diluted with air.	Not stated.
J. P. Hachenberg, Austin, Texas	35 yrs.	Female.	Operation on foot.	Not stated.	Not stated.	Skilled.	Not stated.	Not stated.	Not stated.	A few minutes.
G. W. Shidler, York, Neb.	38 yrs.	Male.	Fistula in ano.	Not stated.	Not stated.	Skilled.	Not stated.	Not stated.	Not stated.	Not stated.

Chloroform to produce General Anæsthesia.

Quantity administered up to this time.	First symptoms.	State of patient at time of accident.	Respiration ceased first.	Heart stopped first.	Time of accident.	Remarks.	Treatment.	Result.
8 c.c. of drug taken.	Patient suddenly livid.	Struggling.	Respiration ceased several minutes before heart stopped.	.....	Operation not begun.	.....	Inverted and artificial respiration.	Death.
Not stated.	Suddenly respiration and pulse ceased.	Not stated.	Both practically ceased at once.	.....	Not stated.	Has seen a number of non-fatal cases have respiratory failure, and resuscitated them.	Inverted and artificial respiration.	Death.
Not stated.	Slight gasps given.	Not stated.	Breathing stopped three minutes; heart continued to beat for this period after cessation of respiration.	.....	Not stated.	.....	.....	
Not stated.	Patient stopped breathing.	Not stated.	Breathing stopped; heart beating.	.....	Not stated.	Everything going well. Drug withdrawn from 2 to 4 minutes before accident occurred.	Inverted and artificial respiration.	Recovery.
Not stated.	Respiration ceased.	Not stated.	Respiration ceased, but pulse continued.	.....	No operation.	After first recovery chloroform again given, and accident repeated.	Artificial respiration.	Recovery.
Full quantity; exact amount not stated.	Respiration ceased.	Probably not struggling.	Respiration ceased; heart beating.	.....	Operation half over.	⅓ grain sulphate of morphine was given before anæsthetic was begun.	Artificial respiration for 25 minutes.	Recovery.
Not stated.	Face suddenly purple; eyes protruded.	Quiet.	Respiration ceased; pulse strong.	.....	Operation over.	Respiration stopped, as bladder was distended with irrigation.	Artificial respiration, inversion, nux vomica, belladonna, whiskey.	Recovery.
Not stated.	Spasm of muscles of respiration; respiration stopped.	Struggling.	Respiration ceased; pulse good.	.....	Operation not begun.	All muscles of respiration very spastic.	Inverted and artificial respiration.	Recovery.
Not stated.	Respiration stopped.	Not stated.	Respiration stopped; pulse good for 5 minutes.	.....	Operation begun.	Respiration stopped as finger touched diaphragm through an incision in belly.	Artificial respiration and stimulation.	Death.
Not stated.	Not stated.	Not stated.	Respiration stopped before heart.	.....	Not stated.	.....	.....	
Not stated.	Not stated.	Not stated.	Respiration stopped before heart.	.....	Not stated.	Operator and others noticed that pulse continued.	.....	Death.
Not stated.	Stopped breathing	Quiet.	Respiration stopped; radial pulse good.	.....	Operation over.	Operator and others noticed that pulse continued.	Not stated.	Death.
Not stated, but large	Respiration ceased.	Quiet.	Respiration stopped, but pulse full and strong.	....	Operation not yet begun.	.....	Artificial respiration and inversion.	Recovery.
....	.....	.....	.....	.....	.....	.....	Artificial respiration and inversion.	Recovery.
Not stated.	Face assumed livid color.	Not stated.	.....	Heart stopped; respiration continued for a few moments.	Operation completed.	Particular attention paid to see which stopped first, heart or respiration.	.....	Death.
Not stated.	Respiration stopped.	Not stated.	Respiration stopped; heart strong.	.....	.....	.....	Artificial respiration.	Recovery.
Not stated.	Pulse stopped; respiration labored.	Not stated.	.....	Pulse stopped; respiration labored.	Operation not completed at time of accident.	Same occurrence three times in same case before operation was completed.	Artificial respiration and stimulation.	Recovery.
Not stated.	Respiration ceased.	Not stated.	Respiration ceased.	.....	Before operation.	The accident being repeated, no operation was done until next day; then under ether, without difficulty.	Artificial respiration.	Recovery.
Not stated.	Stopped breathing.	Not stated.	Respiration ceased.	.....	Not stated.	.....	Not stated.	Recovery.
Not stated.	Cessation of respiration.	Not stated.	Respiration ceased; pulse good.	.....	Just before operation.	.....	Not stated.	Recovery.
Not stated.	Stopped breathing.	Not stated.	Respiration ceased.	.....	Not stated.	.....	Not stated.	Recovery.
Not stated.	Stopped breathing.	Not stated.	Respiration ceased; pulse continued good.	.....	Not stated.	.....	Inverted and artificial respiration.	Recovery.
Not stated.	Stopped breathing.	Perfectly limp.	Respiration ceased; pulse full and regular.	.....	During operation.	.....	Inverted.	Recovery.
Not stated.	Pulse stopped for at least 1 minute.	Not stated.	.....	Pulse could not be felt.	Not stated.	Thinks death would have resulted had he not closely watched the pulse.	Stimulated with ammonia, and fresh air admitted to room.	Recovery.
Not stated.	Stopped breathing.	Deathly pale.	Respiration ceased.	.....	After operation, and patient stood erect.	Attributes the accident to his allowing patient to regain her feet too soon after operation.	Artificial respiration and cold interrupted douche to chest.	Recovery.
3 or 4 drachms	Heart ceased to beat.	Not stated.	.....	Pulse could not be felt; respiration continued for a minute longer.	Not stated.	Patient had taken chloroform ten years ago for extraction of tooth.	Artificial respiration.	Death.

Report of Accidents occurring during the Use of

Name of reporter.	Age.	Sex.	Operation.	State of patient at time of beginning anæsthetic.	Kind of chloroform administered.	Anæsthetist.	How administered.	Rapidity of administration.	Concentration of vapor.	Length of time chloroform had been administered at time of accident.
Louis J. Pons, Roxbury, Conn.	25 yrs.	Male.	Not stated.	Not stated.	Not stated.	Not stated.	On napkin.	Not stated.	Not stated.	Not stated.
J. T. Baldwin, Columbus, O.	Elderly adult.	Female.	Removal of urethral caruncle.	Not stated.	Not stated.	Young physician.	Not stated.	Not stated.	Not stated.	A few minutes.
A. W. Wilmarth, Norristown, Pa.	16 yrs.	Not stated.	No operation; given to quiet epileptic convulsions.	Struggling.	Not stated.	Skilled.	Not stated.	Not stated.	Not stated.	A few minutes.
T. Walter Todd, Redondo Beach, Cal.	Not stated.	Female.	Not stated.	Not stated.	Not stated.	Skilled.	Not stated.	Not stated.	Not stated.	A few minutes.
Louis J. Pons, Roxbury, Conn.	6 yrs.	Male.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.
Thos. R. Savage, New York.	30 yrs.	Female.	Operation upon rectum.	As the patient was insane, it is probable she was not calm.	Not stated.	Not stated.	Esmarch inhaler.	Not stated.	Admixture of air.	Not stated.
Thos. R. Savage, New York.	24 yrs.	Male.	Removal of catheter from bladder.	Not stated.	Not stated.	Not stated.	Esmarch inhaler.	Not stated.	Admixture of air.	Not stated.
Thos. R. Savage, New York.	47 yrs.	Female.	Carcinoma of breast.	Not stated.	Not stated.	Not stated.	Esmarch inhaler.	Not stated.	Admixture of air.	Before anæsthesia was complete.
Thos. R. Savage, New York.	7 days.	Male.	Spina bifida.	Not stated.	Not stated.	Not stated.	Esmarch inhaler.	Not stated.	Admixture of air.	Not stated.

THE CLIMATE OF WESTERN NORTH CAROLINA, WITH A CONSIDERATION OF THE RELATIVE VALUES OF HIGH AND MEDIUM ALTITUDES IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

READ BEFORE THE PAN-AMERICAN MEDICAL CONGRESS IN THE SECTION OF CLIMATOLOGY AND DEMOGRAPHY, SEPTEMBER 4, 1893.

BY KARL VON RUCK, M.D., ASHEVILLE, N. C.

MR. PRESIDENT AND GENTLEMEN:—In speaking of North Carolina, and especially its mountainous part in the western portion of the State, which is already widely and favorably known on account of its climate, I shall necessarily have to repeat what I have stated elsewhere at various times and what has been stated by others before my time.

That part of Western North Carolina known as the Asheville plateau has, in the parlance of climatologists, only a medium elevation of some two thousand five hundred feet above sea-level. There are, however, within a radius of thirty miles of Asheville and encircling the plateau, both higher and lower levels, and within a few hours' journey we can reach elevations varying from twelve hundred to nearly seven thousand feet. If it should appear desirable, these elevations can be made use of in the climatic treatment of phthisis and other diseases.

Some writers, and especially those who practise at much greater elevations than that of the Asheville plateau, convey to us the impression that only the higher levels are really curative in the climatic treatment of phthisis, and that such levels as the one to which I am now calling your attention are a sort of medium, "neither good nor bad." They therefore almost deny to the medium and lower level resorts the right of existence, as being of use only as a makeshift at best, whereby the chances for the patient's ultimate recovery are liable to be trifled away.

If this view is really warranted by the facts, a prompt recognition of it by all who have occasion to send away phthisical patients for climatic treatment would be most desirable.

The inconsistency of the position is, however, manifest, apart from the fact that clinical experience disproves the assertion.

If elevation is beneficial at all,—and no one experienced in phthiso-therapy denies that,—the most that could be claimed *theoretically* would be that it is relatively so, according to the degree obtained; for it would be strange indeed that two thousand five hundred feet should count for nothing, whereas six thousand nine hundred and thirty feet are auspicious!

I hope, however, to show you that a golden mean is not to be ignored any more in this than in many other of our endeavors, and that, other

Chloroform to produce General Anæsthesia.—CONTINUED.

Quantity administered up to this time.	First symptoms.	State of patient at time of accident.	Respiration ceased first.	Heart stopped first.	Time of accident.	Remarks.	Treatment.	Result.
Not stated.	Not stated.	Not stated.	Respiration ceased.	.....	Not stated.	.....	Artificial respiration; hypodermic injection of ammonia.	Recovery.
Not stated.	Respiration ceased and heart feeble.	Not stated.	Respiration; pulse good for some time.	.....	Not stated.	.....	Artificial respiration.	Death.
Not stated.	Respiration suddenly stopped; pulse good.	Not stated.	Respiration ceased.	.....	Not stated.	.....	Artificial respiration.	Recovery.
Not stated.	Respiration ceased.	Not stated.	Respiration ceased.	.....	Not stated.	Same accident occurred twice in this operation.	Artificial respiration.	Recovery.
Not stated.	Not stated.	Not stated.	Respiration ceased.	.....	Not stated.	.....	Artificial respiration; hypodermic injection of ammonia.	Recovery.
Not stated.	Respiration ceased.	Not stated.	Respiration ceased.	.....	Under full anæsthesia during operation.	The same result was experienced a month later in another operation upon her.	Artificial respiration and inversion.	Recovery.
Not stated.	Respiration ceased.	Not stated.	Respiration ceased.	.....	Under full anæsthesia during operation.	.....	Inversion and artificial respiration.	Recovery.
Not stated.	Respiration ceased.	Not stated.	Respiration ceased.	.....	Before complete anæsthesia.	The accident reoccurred several times, and as it was thought this was a case with idiosyncrasy to chloroform, ether was substituted, with satisfactory result.	Artificial respiration.	Recovery.
Not stated.	Cyanosis and arrested respiratory movement.	Not stated.	Respiration ceased.	.....	During operation.	.....	Inversion, and slaps upon back.	Recovery.

things equal, a medium elevation presents advantages over high levels like Colorado and other portions of the Rocky Mountain system, by which we find ourselves clearly the gainers.

At a medium elevation of from two thousand to three thousand feet, like the one of the Asheville plateau, the heart-action is not disturbed to such a degree as is the case at elevations much higher, and while the influence of the change is perceptible at lower levels also, patients do not suffer on account of shortness of breath and palpitation of the heart, so frequently complained of by consumptives in going to high altitudes.

The shortness of breath is in part induced by the rarefied atmosphere, of which a proportionally larger volume is required to convey to the blood an adequate amount of oxygen. In health this is to a degree compensated by deeper respiration; but the patient who has his respiratory capacity perceptibly decreased on account of the changes which have occurred in the lung can make up the deficiency, for the most part, only by increased frequency, or not at all, if the elevation has reached a considerable degree. To this comes the additional disadvantage, that the degree of possible lung expansion is less in proportion as we decrease the atmospheric pressure, which was demonstrated as long ago as 1850 by Pravaz and subsequently by Lange and others, and I have recently repeated their experiments, both under increased and decreased atmospheric pressure, in the pneumatic cabinet. I find, as they did, that if, under ordinary air-pressure, a healthy person performs complete expiration, and thereupon attempts forcible inspiration through a tube connected with a mercury manometer, the mercury is raised four and a half to five cubic centimetres. If now the air-chamber is closed and the pressure in it increased, upon a repetition of the experiment the mercury rises higher in proportion to the increased pressure. If the pressure in the chamber is diminished, the result is reversed and lesser values are obtained than under ordinary pressure, corresponding again to the degree of rarefaction. By practice, higher values are obtained in either case, but the relation of the rise of the mercury in the manometer to pressure and rarefaction remained constant.

The same experiments carried out with patients suffering from pulmonary tuberculosis showed identical results, but it was noted that the inspiratory and expiratory forces were always below the normal, and even in comparatively early-stage cases a diminution of fifteen to twenty-five per cent. was the rule.

It is, therefore, erroneous to believe that the respiratory capacity of the lungs is greater under diminished air-pressure; on the contrary, it is proportionally less, as is also the degree of oxy-

genation of the blood, which is dependent upon it and upon the density of the atmosphere.

If, in addition, we observe the effects of greatly-diminished air-pressure upon the circulation of the phthisical patients, and especially of such as have advanced beyond the very early stages, we find that it is not borne as well as it is in the case of persons having no lung-disease; and while in all cases the peripheral circulation is increased as the surface pressure is diminished, in health the veins can empty themselves freely into the right auricle and ventricle, whence, under increased frequency of respiration with unobstructed lung-tissue, the flow through the pulmonic system to the left heart is equally free, and in this manner an equilibrium between the greater and lesser circulation is maintained.

If, however, the lung cannot fully expand from the too great rarefaction of the air, and if the lung suffers in addition in its expansion by the presence of pleuritic adhesions, thickening, or exudates, or if the parenchyma of the lung is itself the seat of inflammatory changes, infiltrations, or consolidations, then there is a mechanical obstruction placed in the lung to the free flow of blood from the right ventricle through the lung to the left auricle, and the equilibrium between the lesser pulmonic and the greater systemic circulation is easily disturbed or lost.

The heart is now called upon to compensate the disturbance by increased power and frequency of contraction, and under rest or with a strong heart-muscle, when the obstruction is not too formidable, this equilibrium may be obtained or re-established.

If the conditions for perfect equalization of the circulation are not present, then passive pulmonary congestion and heart-strain are the inevitable results. In some cases, at great elevations, this can be only avoided by absolute rest in the recumbent position, while with others it is impossible under all circumstances, and the patient, unless quickly removed to a lower level, soon dies, either from pulmonary hemorrhage, œdema, or heart-failure.

In still others the congestion leads to renewed or increased active, possibly destructive, changes and their consequences, and in all this equalization of circulation is more readily disturbed by comparatively slight causes which at lower levels are inoperative.

The greater the elevation the greater is the liability to these undesirable effects.

At high altitudes much less exercise is, therefore, possible without resulting in pulmonary congestion and heart-fatigue, conditions which cause shipwreck in the journey for health of the consumptive more frequently than all other preventable causes combined.

Consumptives are more liable than others to pulmonary congestion and heart-fatigue at any level: first, because of the obstruction to the circulation produced by the lung-disease, and, second, because of the accompanying nutritive disturbances and anæmia; the heart in most cases is already damaged, weak, and irritable, and seldom in a condition which justifies us in making great or unusual demands upon it, and this is often true even in the early stages of the disease.

It follows, therefore, that we cannot employ altitude in the treatment of phthisis on the principle "the greater the elevation the better for the patient;" and I find from practical experience that, even at a medium elevation of two thousand three hundred and fifty feet, the tendency to heart-fatigue is more manifest than I have found it to be at places with lower elevations.

I have thus had occasion to advise the removal of patients to lower levels because of circulatory disturbances, in the absence of actual heart-disease, which were unquestionably due to the reduced atmospheric pressure, inasmuch as they did not exist before leaving home, and promptly subsided when my advice was complied with.

Any unusual demand upon the heart—be that on account of change in the atmospheric pressure, physical exercise and labor, or other strain—must, therefore, have our careful consideration, and be avoided unless in cases where we are reasonably sure that the heart is adequate to the demand and that our patient will be benefited thereby.

The liability of consumptives to heart-strain, with its consequences, exists also when going from high altitudes to considerably lower levels, and, other things being equal, the effects are in proportion to the degree of change in atmospheric pressure and the rapidity with which the change is made.

At a medium elevation these effects are better borne because the strain is less, and patients still in a condition where improvement and cure can reasonably be looked for can come to and return from lower levels with greater safety.

The danger of returning to sea-coast localities of patients who were considered cured at the high elevations of Colorado and New Mexico is recognized even by the laity, and physicians, both at the elevated stations and at home, recognize the fact by advising against it, so that it practically means exile from home

and friends and from former associations for life, to send consumptives to very high elevations, to say nothing of the dangers and disadvantages to which they may be thereby exposed.

If it were true that by these means only a relative cure can be accomplished, the sacrifice and risk would be imperative although regretable.

There are still other disadvantages of high-level resorts, among which I may mention the great ranges of temperature.

Extremes not only in altitude but also in temperature are undesirable for the consumptive.

If he is to live out of doors as much as possible, he must avoid great degrees of cold, against which he finds it difficult to protect himself, especially when not taking active exercise, and against the enervating extremes of heat he cannot protect himself at all.

With these extremes occur great and sudden variations in temperature, and these the consumptive feels to his detriment in any stage of the disease.

According to Dr. J. W. Gleitsman, who made temperature comparisons between some high-altitude resorts of Colorado and the medium elevation of Asheville, N. C., in 1874, a temperature of 90° F. (with a maximum of 102° F.) occurred at Denver, Col., fifty times and at Colorado Springs thirty-nine times during the same summer, when at Asheville, N. C., only once a temperature as high as 88° F. was observed. He also found similar, only reversed, extremes for the winter months, during which, owing to its geographical position and lower altitude, the Asheville plateau, with an average of 49° F. for the winter months, is free from severe cold weather. Snow rarely falls, and when it does, the sun usually melts it away on the same day.

That a happy medium is best is also true as to "a comparatively dry climate," which constitutes another desirable factor in the climatic treatment of phthisis.

Too great dryness of the air is, however, undesirable, becoming frequently a source of irritation to the lungs and throat, and Dr. Rudi, of Denver, recognizing the disadvantage, advises the generation of steam in the patient's sleeping apartment.

Great dryness of the air is associated with prolonged dry spells and the absence of rain, which means a large amount of dust floating in the air, the inhalation of which should be avoided in all lung- and throat-affections.

At lower levels the air contains relatively more moisture, and upon the Asheville plateau the average relative humidity for the entire year is sixty-five per cent., while at some points in Colorado and New Mexico it is no doubt much lower.

Sixty-five per cent. is, however, relatively

The United States Weather Bureau Meteorological Observatory at Winyah Sanitarium, Asheville, N. C.

SUMMARY OF METEOROLOGICAL RECORDS FOR THE YEARS FROM 1888 TO 1892 INCLUSIVE.

Elevation, 2350 feet. Latitude, 35° 36′ N.; longitude, 82° 26′ W. Hours of observation, 7 A.M., 2 P.M., and 9 P.M

Years.	Season.	Mean temperature.	Mean maximum temperature.	Mean minimum temperature.	Absolute maximum temperature.	Absolute minimum temperature.	Mean daily range of temperature.	Mean daily variation of temperature.	Mean relative humidity.	Mean absolute humidity in grains of moisture per cubic foot of air.	Mean number of clear and fair days per month.	Number of cloudy and rainy days per season.	Mean number of days without sunshine per month.	Mean number of days on which 1/10 inch or more of rain fell per month.	Mean per cent. of ozone of possible amount per month.	Mean barometer (corrected for altitude and temperature).	Mean amount of rainfall in inches per month.	Direction of prevailing winds.	Mean force of wind, scale 0 to 6.
1888–89	Winter.	44.46	55.35	35.46	69.50	20 20	19.73	2.45	60.12	2.177	24.3	6.3	1	11.5	51.00	30.13	4.36	N.	2.12
1889–90.....	"	48.68	59.30	37.93	74.30	18.50	21.33	2.80	64.60	2.585	27.6	3.0	2	13.3	40.20	30.15	4.29	N.	2.44
1890–91.....	"	45.18	55.56	72.68	63.33	17.98	20.23	2.85	63 40	3.771	25.0	6.0	0	11.6	56.00	30.14	4.83	N.	1.80
1891–92.....	"	44.83	55.11	33.73	60.40	16.16	21.37	2.65	64.78	2.009	25.0	6.0	1	11.0	55.10	30.13	1.64	N.W.	1.45
Sums.....	....	183.15	225.32	179.80	269.53	72.84	82.66	10.75	252.90	10.532	101.9	21.3	4	47.4	202.30	120.53	14.52	....	7.91
Means for 4 years.	Winters.	45.79	56.44	44.95	67.38	18.21	20.66	2.69	63.22	2.633	25.4	5.3	1	11.8	50.57	30.13	3.63	N.	1.98
1889.....	Summer.	64.97	75.83	54.33	85.30	39.50	21.33	3.00	70.98	4.360	24.5	5.3	1	6.5	.....	30.18	2.09	N.W.	1.39
1890.....	"	65.24	76.00	56.25	85.63	45.20	19.73	2.70	71.00	4.290	24.6	5.5	0	9.6	49.40	30.25	3.12	N.W.	1.41
1891.....	"	65.49	76.59	54.57	86.60	43.00	23.00	2.60	68.06	4.230	25.5	8.9	1	11.1	44.22	30.18	3.94	N.W.	0.80
1892.....	"	67.68	78.63	57.45	88.40	46.60	21.00	2.80	71.37	1.640	20.0	10.0	0	9.5	53.42	30.02	3.98	N.W.	1.00
Sums.....	....	263.58	307.05	222.60	345.93	174.30	85.06	11.10	281.41	14.520	94.6	29.7	2	36.7	147.04	120.63	13.13	.....	4.50
Means for 4 years.	Summers.	65.89	76.76	55.65	86.48	43.30	21.24	2.77	70.35	3.630	23.6	7.4	½	7.4	49.00	30.15	3.28	N.W.	1.12

dry, and compares favorably with the lowlands, where the average is in the neighborhood of eighty per cent.

The number of clear and fair days at a given climatic resort is also important, as upon them depends largely the patient's ability to derive the full benefit of climatic treatment in living out of doors as much as possible.

Many of the localities with medium or lower elevations will compare in this respect with the higher levels, and the Asheville plateau has averaged twenty-five clear and fair days for each month in the five years since the establishment of the United States Weather Bureau in 1888. In the past year there have not been more than three or four days on which my patients did not have the advantage of out-of-door life on account of unfavorable weather.

The Asheville plateau can, therefore, claim freedom from all extremes in elevation, temperature, or humidity; it has every condition favorable to out-of-door life; it is an all-year favorable locality, where in the residence of the invalid no change is required with change of season. It is easily accessible, being within twelve to twenty-four hours' travel of the Eastern, Southern, and Middle States, obviating the more serious and frequently detrimental fatigue from days of travel to localities of greater elevation and greater distance.

That such resorts of medium elevation deserve consideration is apparent from the estimation in which they are held by the profession, and much lower levels than the Asheville plateau have shown excellent records in improvements and recoveries obtained, and the facts presented regarding the disadvantages of high altitudes outweigh, in my judgment, any supposed advantage claimed for them; but, apart from the foregoing considerations, we must consider as our best guide the clinical results obtained, and compare them.

Speaking for Western North Carolina, and the Asheville plateau in particular, I am able to record equally good, if not better, results than have ever been shown for the high-level resorts, and, without going into details, I can say that in the truly early stage I have for several years past obtained one hundred per cent. of recoveries in all cases who remained a sufficient length of time to justify the expectation, while not a single early-stage case has failed to show improvement from even a comparatively short season of residence.

The high-level resorts cannot possibly do better, and with these results the plea for more than medium elevation must fall to the ground.

I have now records of five hundred and eighteen cases treated and discharged more than two years and as long as five years ago.

The permanency of the results in these cases was inquired into this past winter by correspondence with patients, their relatives, or their physicians.

With but few exceptions, they have all returned to their previous places of residence, and the answers received show that a cure or permanent arrest of the disease continues in one hundred and eighty-one, or thirty-five per cent.; two hundred and ninety-six others, or fifty-six plus per cent., continue still improved as compared with the time of their arrival at Asheville; and only seventy patients have grown worse or have died.

Not until better results and of equal duration can be shown for higher-altitude resorts need the profession seriously consider any possible advantage they may claim over lower or medium levels.

In conclusion, I desire to say that I am not unmindful of excellent results obtained in high altitudes, especially in the early stage, nor of the fact that the statistics of the high-level resorts are seriously clouded by the unfavorable course and bad results in cases at all advanced in the disease, and who were erroneously sent to them.

I claim, however, that such early-stage cases could have derived the same benefits at lower levels without subjecting them to the dangers pointed out in the earlier part of this paper, and that many of the advanced cases who fail to improve or grow worse at high altitudes could derive benefit at places having only a medium elevation.

DISINFECTION IN 1893.

LAVRAND (*Journal des Sciences Médicales de Lille; Revue Général de l'Antisepsie*, 6 année, tome i.) states that theoretically we are now thoroughly equipped for a victorious struggle against nearly all infectious and epidemic diseases; but, as a matter of fact, there is no antiseptic which in its practical application to the needs of daily life will give the results which are obtained in the experimenter's laboratory.

The recognized disinfectants of the day are heat and certain chemical substances, also the desiccating action of air and direct sunlight. Heat is applied by means of boiling water to which has been added carbonate of soda, by steam under pressure.

The most reliable chemical agents are solutions of carbolic acid, 5 per cent.; chloride of mercury, 0.1 per cent.; quick-lime, chloride of lime, and lysol.

The Therapeutic Gazette

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Leading Articles.

CONCERNING MILD CONJUNCTIVAL INFLAMMATIONS AND THEIR LOCAL TREATMENT.

IT has been estimated that about sixty-three per cent. of patients applying for treatment of their eyes in hospital service, and probably half that number in private practice, suffer from one or more of the diverse types of conjunctival disease. Not the least important, so far as the comfort of the patient is concerned, are the minor inflammations,—irritations, hyperæmias, and mild conjunctivitis. Often rapidly dissipated by means of simple soothing lotions, they occasionally cling with aggravating persistency to their area of occupancy. Even when the cause is removed—local irritants, lachrymal obstructions, diseases of the nasopharynx, various states of depraved health, vaso-motor disturbance, and eye-strain, either from defective muscular balance or from uncorrected ametropia—the conjunctiva may be long in assuming a normal aspect.

For more than a dozen years solutions of boric acid have been much employed by ophthalmic surgeons under these circumstances, as well as for inflammations of a higher grade which affect this membrane. A saturated solution (about four per cent.) would be a suitable strength were it not that there is a tendency, with the changes of temperature, for the drug to be deposited at the bottom of the vessel which contains the lotion; hence it is ordinarily employed in three-per-cent. solution, in which strength it is detergent, slightly astringent, and moderately antiphlogistic, at least these are the virtues to which its favorable action is usually ascribed. True, feeble antiseptic properties are also attributed to it, but if at all efficient in this respect, the concentration should be about 1 to 13, and not 1 to 33, as it is generally used; and as this concentration is not possible except under special conditions, it does not avail in practical therapeutics.

The detergent properties are probably the most important. Alkalinity of the lotion and corresponding improved cleansing power may be effected, as suggested by Jackson (*Philadelphia Polyclinic*, August, 1893), by the addition of sodium biborate in the proportion of four grains to the ounce, although his statement that a solution of boric acid itself is faintly alkaline is not in accord with generally accepted ideas, nor with tests which have been made to ascertain the accuracy of this assertion. Probably owing to the slight astringency of boric acid, many patients complain of an unpleasant dry sensation after its solution has been applied to the conjunctiva. It may be almost wholly avoided without destroying this or any other qualities of the drug, by adding two to four grains of sodium chloride to the mixture. Indeed, the addition of the salt enhances the therapeutic value of the lotion.

The usual method of applying these solutions is with a pipette or by means of an "eye-cup," but distinct advantage is gained by atomizing the fluid with an ordinary hand instrument or, still better, with the aid of an air-compressor, the pressure being just sufficient to create a uniform gentle spray, which is allowed to play upon the inflamed or irritated surfaces. The liquid thus applied readily cleanses the affected areas, and probably medicates not merely their surface, but slightly penetrates the tissues and correspondingly increases the extent of the contact and prolongs

the action of the drug. It is not improbable that equally good effects may be secured with a physiological salt solution, or even with boiled distilled water; but the distinct value of the drugs just described is so universally conceded, and, indeed, demonstrated, that no good reason can be assigned for dismissing them from practice.

When the conjunctival affection assumes a hyperæmic type, abnormal secretion being practically absent and the congestion largely confined to the bulbar conjunctiva, excellent results are obtained by using a method advocated by Königstein ("Die Behandlung der häufigsten und wichtigsten Augenkrankeiten," Wien, 1889) in the treatment of vaso-motor blepharitis,—namely, douching the closed lids with water at a temperature of 60° F. from a vessel raised a short distance above the head of the patient, the fluid being conducted through a small apparatus in the form of the rose ordinarily seen upon watering-cans, and thus distributed in fine shower-like jets. The temperature of the water may be varied according as a hot or cold lotion is indicated, and the application is more agreeable, if not more efficient, by the addition of a little eau de Cologne.

Washing of the eyes with tepid water and Castile soap is productive of good results,—a method likewise suited to forms of moderate conjunctivitis characterized by a secretion just sufficient to glue the lids in the morning. It is astonishing how this simple procedure, much employed by Knapp in preparing eyes on which the operation for extraction of cataract is to be performed, will subdue redness and irritability of the conjunctiva and margins of the lids. The stronger astringents and antiseptics,—alum, sulphate of zinc, bichloride of mercury, and particularly nitrate of silver,—while fulfilling evident indications in more aggravated lesions of the conjunctiva, are not applicable to these moderate affections, which yield more readily to the mild measures which have been described.

ANÆSTHESIA.

IN this number of the THERAPEUTIC GAZETTE there appears an article giving the results of a research upon the action of chloroform, which was instituted with the object of reconciling certain divergent views upon this much-discussed topic. For the results which have been obtained we refer the reader to the article itself, but there are other questions connected with this subject not there discussed. It is not intended in this editorial to raise the old question of the relative safety of the various anæsthetics. The object is to emphasize the fact that there are indications governing the employment of the various anæsthetics, which indications should be followed quite as rigorously as are the indications which govern the employment of digitalis, strophanthus, alcohol, or nux vomica in the treatment of cardiac disease. There are probably no drugs which are so commonly employed by routine as are the two anæsthetics, chloroform and ether. In the Atlantic States, certainly the Northern Atlantic States, ether is practically always employed, and so general is this use that the surgeon simply instructs his assistants to anæsthetize the patient, knowing that they will employ ether as a matter of course. On the other hand, in the southwestern part of the United States the employment of chloroform is equally a matter of routine. There are, of course, certain grave reasons for the employment of chloroform as a matter of routine when the temperature is high and when the altitude is such that the employment of ether is difficult and expensive. It is also true that in the presence of a great emergency chloroform must be used in order to anæsthetize a large number of individuals in a short time. And, again, it is necessary in some instances where disease of the blood-vessels or kidney exists to use chloroform in preference to ether. These facts are pointed out in the paper to which we have already referred.

Of one thing we are confident in regard to the use of anæsthetics, that they are too freely and frequently administered. There are a large number of cases which require no general anæsthesia for the relief of suffering, and this is particularly the case since cocaine has been introduced. Again, in many instances the full physiological effect of the anæsthetic is produced, although the operation is so much of a minor one that in reality only a few whiffs of the drug are necessary. In most of the minor operations, such as opening abscesses and boils, it will be found that by the careful administration of chloroform or ether sufficient anæsthesia is produced in the primary stage of the influence of the drug to almost entirely prevent pain, and by this means the patient avoids the depression and prolonged convalescence which always follow full anæsthesia. In instances where the operation is a minor one, and yet is too severe or prolonged to permit of the use of primary anæsthesia, we believe that bromide of ethyl is the anæsthetic which should be resorted to. In earlier numbers of the THERAPEUTIC GAZETTE evidence has been adduced, both in the Original,

Editorial, and Progress columns, of the value of this liquid, which we believe has been unjustly ignored. There is no substance which can absolutely destroy consciousness, and by so doing act upon the most vital portions of the nervous system, without some danger, and without in some instances producing more or less after-effects, but there is no evidence that bromide of ethyl produces disagreeable symptoms as frequently as do chloroform and ether, while its rapid and fugitive action enables the surgeon to place the patient beyond the reach of pain in a few seconds and to bring him back to consciousness in an equally short time.

Finally, we are convinced that in a certain number of cases all anæsthetics produce changes in the nervous system which are not generally recognized; particularly is this the case if the anæsthesia is prolonged and profound. Careful observation will certainly result in the recognition of cases in which the imprint of the anæsthetic in a more or less definite form remains upon the nervous system for days and weeks after the more prominent evidences of the action of the drug have passed away.

THE TREATMENT OF TETANUS BY AMPUTATION.

IN recent numbers of the THERAPEUTIC GAZETTE there have been reported a number of cases of tetanus treated by amputation, some successful, others not so; but without exception the operators have, under proper restrictions, appeared to favor this procedure. Berger's contributions to this subject are perhaps most striking, and, in so far as limited statistics are of value, would seem to show quite positively the advisability of practising amputation. Verneuil (than whom no one has studied the question more thoroughly) publishes an important communication in the *Gazette Médicale de Paris* for June 10, 1893, in which he records some unsuccessful cases, and puts himself positively against the idea that amputation will have any marked effect upon the prognosis of tetanus, once developed. Indeed, he goes farther than this, agreeing with Poncet, of Lyons, that far from curing or even mitigating the violence of the disease, a major operation of this kind seems to distinctly stimulate it, changing it from the mild and chronic form to one extremely acute and rapidly fatal. In Verneuil's paper cases are cited in which amputation was performed before the appearance of tetanus, either because of the severity of the original injury or because of consequent sloughing and gangrene, yet tetanus subsequently appeared and ran a rapidly-fatal course.

One case is particularly interesting, as tending to disprove the basis upon which amputation is advised,—that is, the belief that this operation enables the surgeon to remove the focus of infection.

A young woman entered the hospital on the 16th of March with a contused wound of the hand. This was carefully cleansed, closed, and received a dry dressing. Two days later the wound was thoroughly disinfected, some sloughs and shreds of cloth were removed, and a wet dressing was applied, combined with daily immersion for one hour in carbolic solution. This treatment was continued for ten days. There was very slight discharge and the wound appeared healthy. On the eleventh day of this wet dressing, and the thirteenth after her injury, the patient exhibited slight trismus. Two days later the symptoms were so marked that there was no further doubt about the diagnosis. The forearm was amputated, and the patient was given morphine and chloral in full dose. On the day of operation eighty cubic centimetres of antitetanic blood-serum were injected by Roux, though this surgeon stated that neither his experience with animals nor his trials in the human gave him any hope as to the beneficial effect of the treatment. Death followed in less than twenty-four hours after the operation from acute tetanus.

Roux very carefully examined the amputated hand, but was unable to find the tetanus bacillus.

Verneuil does not hesitate to say that the antitoxine injections are simply a second edition of Koch's lymph, and will be found equally futile in therapeutics.

His communication is of great interest and importance, as tending to prevent the adoption of extreme measures until their value is much more definitely proved, and it also affords comfort to surgeons who have possibly felt that they were not doing their full duty by tetanic patients in not securing for them the antitetanic serum. The early reports of this treatment were favorable. The investigators seemed to have carried the treatment beyond the experimental point and to have proved the serum of such value that it should be used in every case. When men of the standing of Roux and Verneuil express their disbelief in this method, a disbelief founded upon trial, it again puts the matter in the experimental stage, and frees the surgeon from all responsibility as to its use.

THE USE OF MILK IN BRIGHT'S DISEASE.

ALTHOUGH it is true that many physicians have widely divergent views as to the diet which certain cases of Bright's disease should receive, and while some of them insist very strenuously upon an absolute milk diet, there are others who go even farther than this and direct that the milk which the patient receives shall always be skimmed. It is not our intention to discuss the relative values of the various dietetic measures which have been instituted, nor indeed of the milk treatment of this condition, but we desire to call attention to an error which, we believe, underlies the administration of skimmed milk in such cases. The main object of all dietetic treatment of Bright's disease is to prevent the ingestion of excessive quantities of nitrogenous material, and theoretically even the nitrogenous principles of milk are harmful. Practically, of course, it is necessary that the patient should receive food containing nitrogen, and milk is therefore used as the best food which we can obtain. If the milk is skimmed, one of the most nourishing principles of it is taken away from the patient, and the part that is taken away contains practically no nitrogen as compared to what remains, and is therefore the part above all others which will do most towards nourishing the patient. We believe, therefore, that whole milk should be given to cases of Bright's disease rather than skimmed milk. It is, however, not to be forgotten that one good reason for removing the cream before giving the milk to such cases is that the fatty material sometimes disagrees with the patient's digestion. This can practically always be avoided by the administration of pancreatin or, better still, by diluting the milk until the proportion of fatty material to liquid is so diminished as to make indigestion from this cause an improbability. The milk may be either diluted with plain soda water or Apollinaris, or with Vichy, preferably the two first. The carbonic acid gas seems at once to aid digestion by stimulating the stomach, and perhaps by aiding in the breaking up of the curd.

Reports on Therapeutic Progress.

THE ACTIONS OF CHLOROFORM.

In an exceedingly interesting and important communication to the Académie Médecine, bearing upon the long-mooted question of the action of chloroform, J. V. LABORDE (*Bull. de l'Académie de Médecine*, July 17, 1893) has endeavored to demonstrate experimentally that the primary accidents of chloroformization—such as the arrest of the heart and respiration—are due to an essential, predominant action of the drug exercised on the peripheral ends of the sensitive nerves of the nasal mucous membrane,—that is, upon the terminal fibres of the trigeminal. The author has heretofore shown that the vapor of chloroform applied to the nose of a rabbit, or touching the nasal mucous membrane with a sponge charged with the anæsthetic, only produces a special irritation locally. As a consequence of this, there is an immediate stoppage of the lever that is recording the cardiac and respiratory movements. On the other hand, if the nasal mucous membrane is rendered non-sensitive by the application of a local anæsthetic like cocaine, or a general one like opium or morphine, or, again, if section of the trigeminal is practised beforehand, then the arrest of the heart and the respiration no longer take place.

To make the subject more clear, and at the suggestion of Guerin, Laborde, assisted by Rondeau, made the following experiment: Tracheotomy was performed upon a rabbit; a tracheal canula was inserted, through which a tube could be introduced for the administration of chloroform by this means. At the same time a pneumo-cardiograph was so connected with the animal as to transmit upon a recording instrument, by means of a vertical lever which could be seen at a long distance, the movements of both the heart and the respiration. Now, when the chloroform was introduced through the tracheal canula, no appreciable effect was noticed on the transmitting lever to indicate alterations in the cardiac and respiratory movements; the animal remained absolutely quiet; it did not stir. On the contrary, when the anæsthetic, by means of a sponge, was administered by the nose, there followed an immediate and *complete arrest* of the lever; in other words, there was a simultaneous stoppage of the heart and the respiration. The animal was allowed to recover, and the experiment repeated with exactly the same results.

Commenting upon the results of such an experiment, Guerin thought that it had been clearly demonstrated that the action of chloroform upon the heart at an early stage of anæsthesia depended on disturbances of the reflexes, disturbances traceable to the nasal mucous membrane; and that, clinically, the disturbances of the nasal reflexes played an

important part in certain instances of respiratory arrest. It is possible that chloroform, which, by acting upon the nasal fauces, produces cardiac paralysis, may also, by affecting the glottis, cause respiratory arrest, although this latter phenomenon has not been demonstrated experimentally. He believed that fatal cardiac syncope generally occurs at the beginning of chloroformization; and, further, that arrest of the heart is by far more dangerous than the suspension of the respiratory function, since the former is almost always a sign of certain death. Le Fort cited a fatal case in support of the danger underlying the disturbances of the nasal reflexes.

[Laborde's conclusions are directly opposed to those reached by Wood and Hare and quoted in the Chloroform Report in this number of the GAZETTE, probably because of the extreme sensitiveness of the rabbit's respiratory mucous membrane and its different nervous mechanism governing respiration and circulation.—ED.]

NAPHTHOLATE OF BISMUTH.

This substance is a neutral brown powder, without odor, not astringent, and insoluble in water, but decomposes in the intestine into beta-naphthol and bismuth.

NENCKI and HEUPPE found it of value in the treatment of cholera, in the dose of 15 to 30 grains a day. Similarly they have employed the tribromophenate of bismuth in choleraic diseases. This preparation is also a yellow powder, neutral, insoluble, without odor, and insipid. It has no toxic action upon the mucous membrane of the alimentary canal. In 100 parts there are 50 parts of tribromophenate and 50 of oxide of bismuth. The dose for adults is from 60 to 75 grains a day, which should be divided into many doses. It is thought that these two substances are singularly efficient intestinal antiseptics.—*La Médecine Moderne*, June 7, 1891.

SUBCUTANEOUS AND INTRAVENOUS INJECTIONS OF SALT WATER.

In the *Medical Press and Circular* for June 7, 1893, RITTER VON HACKER contributes an article to the literature of this subject.

There are two methods of introducing fluids into the organism, the one subcutaneous, the other intravenous, both having been severely criticised and warmly advocated, more especially during the recent epidemic of cholera. The utility of injection, however, in many diseases besides cholera, such as great loss of blood, etc., has been recognized for some time past, but the manner of introducing the fluid has drawn forth a diversity of opinion. The intravenous was first used in acute cases of hæmatic change, such as puerperal and surgical anæmia, with apparent success, after Kronecker and Sander had demonstrated on animals the beneficial effect after injections by the vena media and the saphena. The physiological conditions on the circulation instantly arrested mechanical death by hemorrhage, which had led to rapid depression in the blood-pressure, sudden ischæmia, and destruction of the vital centres. Judging from the beneficial effects, similar results would be obtained in man. Great improvement in many of these cases so near the end took place, and the opponents of the method could not deny that success was frequent. The author recollects the first case he conducted in Nothnagel's clinic, and believes that in the first intravenous infusion of salt that was tried in Austria the ultimate result was not crowned with success, as could hardly be expected. It was a severe case of hemorrhage from an ulcus ventriculi, the collapse threatening to be fatal. After injection he recovered, however, but a second attack of hemorrhage was fatal. The section revealed a large rodent ulcer of the arteria lienalis. From this period injections of salt and water have gained in favor.

After the practice of direct injection into the veins had been established, a more innocent and probably easier method was advocated by Michael,—viz., the subcutaneous method. It was proved that this form of injection into the tissue obviated the danger of rapidly filling the vessels and producing death. Sahli carried out the latter method of treatment in other pathological conditions, such as uræmia, typhus, etc.

The recent cholera epidemic has stimulated the activity of therapeutists to the practice of both these methods, in whose hands they have assumed what might be designated party names, the subcutaneous being that practised and advocated by Cantani and Samuel. Cantani claims to have used this form of treatment, under the name of "hypodermoklyse," during the epidemic of cholera in Italy in 1884. The intravenous injection of salt water is associated with Hayem's name, who claims for it a superiority over the hypodermic method.

The object of both methods in cholera is to rapidly supply the circulation with the necessary saline fluid which is supposed to be deficient and the cause of rapid death. By either of the methods improvement cannot be

denied: the circulation is increased, diuresis established, and the easy removal of the cholera toxine favored. At the present time all are agreed that an injection of salt water in cholera will reduce the pulse and temperature, but it is yet doubtful how the fluid acts on the toxine of the cholera bacillus, although the facts obtained from the late Hamburg epidemic prove it to be a powerful restorative remedy in imminent fatal cases. Whether subcutaneous or intravenous, the same conditions are fulfilled,—viz., the providing of fluids in the arid tissues. Schede, of Hamburg, is in favor of subcutaneous infusion combined with intravenous injection into the centripetal vessels, not concurrent, but in succession. Michael and Kumel have obtained similar successes by subcutaneous infusion, while Lauenstein expresses confidence in the intravenous infusion, and assures us that it is less dangerous than supposed. In hospitals, or where suitable assistance can be afforded, there is no danger with intravenous infusion. According to Ziemssen, no danger is incurred by driving the needle directly into the vein without any previous preparation, as the danger from air is very trifling and almost nothing. The failures recorded depend more on the want of experience. For the general practitioner, however, the subcutaneous infusion may be the most easily accomplished. The statistical results of the Hamburg epidemic are conflicting, and therefore cannot be relied upon for deciding the best method at the present time. It is generally accepted, however, that the subcutaneous is easy to manage and within the ready control of the practitioner. At the beginning of an epidemic the mortality is usually greater than later on, hence the difficulty of drawing conclusions. The report of Dr. Jolasse on subcutaneous and intravenous infusion gives us of the former 104 cases; of which 92 died and 12 recovered, making 11.5 per cent. recoveries. In the latter, 167 cases are given; 130 died and 37 recovered, leaving a percentage of 22 recoveries. Schede records 58 cases intravenous, with 25.8 recoveries, thus giving considerable favor to the intravenous over the subcutaneous treated by themselves. Other operators, however, such as Eisenlohr, obtained thirty-three per cent. recoveries by the subcutaneous method.

This method might be properly described first in its relation to cholera, for which it has been lately applied. It is simple in arrangement and easy to perform with a Pravaz's injection, although a larger quantity of fluid is introduced. The hands, instruments, and apparatus must be all well disinfected before commencing the operation, the hands being freely washed with soap and warm water, and afterwards held a minute in a two-per-thousand sublimate solution, or a three-per-cent. carbolic. The usual part for injection is the abdomen, which should be well rubbed with sulphuric ether by Bruns's wadding, then followed by a two-per-thousand sublimate or a three-per-cent. carbolic solution. The manner of sterilizing the apparatus must vary with the material used, but the safest method would be to boil them half an hour before use, afterwards dipping them in a one-per-thousand sublimate, eighty-per-cent. alcohol, or a solution of carbolic acid for a minute. The whole may be easily sterilized in the usual apparatus, if such be at hand: the necessary articles are a needle or fine trocar, india-rubber tube, and a syringe to drive in the solution. The lumen of the needle should be one and a half to two and a half millimetres in diameter, and it should have several side openings, allowing the fluid to pass in all directions among the tissues. It may easily be performed with small trocars, such as those used by Cantani, Frantzel, or Billroth. Professor Ewald, of Berlin, practises the operation with a simple trocar. On the end of the canula is fitted a gum-elastic tube, through which the trocar is inserted and pushed into the cellular tissue. After this it is slightly withdrawn, allowing the fluid to pass in while the elasticity of the gum catheter contracts on the trocar, preventing the admission of air. Cantani's trocar is certainly more suitable for this operation, and being metal throughout, can be boiled and thoroughly disinfected with reagents. The construction of this instrument is similar to Billroth's for performing thoracotomy. The gum-elastic tubes should be made of reddish-brown caoutchouc. This material is easily disinfected, half an hour's boiling being sufficient. If boiling be not practicable, such tubes should be kept in disinfected fluid, as a five-per-cent. carbolic, for two or three days at a time, repeating this operation every fourteen days for a few weeks. Neglecting thorough disinfection, Simmond, of Hamburg, has recorded several cases where phlegmonous inflammation occurred in the abdomen after a subcutaneous operation. It is advisable to keep the needles and drainage-tubes in separate solutions before immediate use. The next preparation is the entrance of the fluid, which can be best effected by a glass reservoir elevated as an irrigator. Syringes are objectionable, owing to the difficulty of excluding air. Nothnagel and Kahler recommend glass burettes, but a vessel is easier disinfected and safer to move about, and the heat

longer retained than in long burettes. Cantani's apparatus closely resembles the irrigator, but may be divided into two parts by a metal connection; the internal section contains a thermometer and a solution heated to 39° or 40° C.

The composition of the infusion itself is not so easily determined. Cantani recommends, and Nothnagel and Kahler support the opinion, that two litres of distilled water should contain six grammes of carbonate of sodium and eight grammes of the chloride of sodium. It is proposed that the chemist have three grammes of the one and four of the other prepared in packets, which should be well disinfected and ready for the prompt requirements of the practitioner; this would suffice for one litre of water. Too much care cannot be exercised in having the material as pure as possible. Lauenstein, of Hamburg, has shown how much impurity exists in many of the compounds after he has sterilized and filtered them.

The region of the body for subcutaneous injection is preferably located in the trunk, and more particularly in the ileo-costal, inguinal, and infraclavicular portions, although the inner side of the arm has received many advocates. The supraclavicular region and neck should be avoided, as œdema of the glottis might produce dangerous suffocation. The intrascapular region is also recommended, and might be a very suitable situation in cholera cases were it not for the water that oozes out when the patient is laid on his back, making the bed very uncomfortable. The greater number prefer entering by two different parts of the body. The needles should be well pushed forward in the first instance, and then slightly withdrawn to aid the introduction of the fluid. The wound should then be closed with iodoform plaster or collodion.

The quantity injected, according to Sahli, should be one to two litres in from five to ten minutes. Cantani recommends that in cholera it should never exceed one and a half litres. It may, therefore, be safely affirmed that one litre in the same time should be inserted, and if two needles are used, half a litre through each. This applies more especially to the asphyxia stage of cholera; when below this point eight hundred cubic centimetres may suffice, and in the typhoid stage five hundred cubic centimetres. As a general rule, this infusion must be repeated every four hours, until the pulse begins to rise, the breathing becomes freer, the cyanosis disappears, and the secretion of urine commences. With respect to the temperature, Cantani considers that the solution should be from 39° to 49° C. when the phenomena of cold and paralysis supervene; in the typhoid stage, 37° to 38° C. Samuel prefers injecting fifty cubic centimetres in the minute, after an interval of one minute another fifty cubic centimetres, and so on till the pulse becomes sensible; then he reduces it to every five minutes. If the pulse becomes stronger, every half-hour, and so on till free urination occurs. If a reappearance of the symptoms occur, the operation is repeated. The usual quantity throughout a case varies from eight to twelve litres.

The apparatus in this method are similar to those used in the subcutaneous, with a difference that only one needle is used, and, instead of it being of metal, it is usually of glass. After the vessel has been reached, its direction is centripetal. The veins of the extremities are usually selected: in the arm, the vena mediana; in the leg, the vena saphena. The vein that can be easily approached from the surface is the more suitable for this operation. The hands and instruments are disinfected after Fürbinger's method. An incision several centimetres long is made through the skin; the veins separated two to three cubic centimetres wide to allow of Dechamp's artery needle. Three silk ligatures having been well disinfected by boiling an hour in a five-per-cent. solution several times, one of these is placed on the peripheral line of the vein; the central end may be loosely tied or caught with forceps. A V-shaped section is taken out of the vessel, leaving the base towards the centre; the end is caught with forceps, and the canula, through which some of the solution has been passed, is then introduced into the vessel, and the ligature applied over the canula and vein. The forceps or loose ligature in front of this is next removed, and the fluid allowed to pass into the vessel. Care must be taken to have the apparatus working before introduction, in order to prevent admission of air. The vessel containing the infusion should be elevated a half to a metre above the site of operation. Any of the foregoing instruments may be used for the intravenous infusions, but the glass irrigator of Gartner is preferable. The author prefers Erlenmeyer's flask. When a sufficient quantity has been introduced,—one and a half to two litres,—the clamp is applied to the india-rubber tube, the ligature in front of the canula tightly tied, and the canula withdrawn, the vein being cut away with the canula and the wound closed. Less time is required in this operation than the subcutaneous, the influence is more rapid, but the dangers are increased.

Hayem recommends the following infusion:

Aquæ destill., sterilizat., 1000 grammes;
Chloride of sodium, 5 grammes;
Sulphate of sodium, 10 grammes.

In cholera he has introduced two to two and a half litres of this fluid in a quarter of an hour; a single injection sometimes suffices. If the pulse becomes thread-like, a second is repeated, which may occur at the end of ten or twelve hours. The effect on cholera cases, as well as those of hemorrhage, is marked improvement in pulse, breathing, and cyanosis. The patient may sometimes experience during or immediately after the operation a rigor; the temperature, if abnormally high, will be reduced; if low, raised to the normal point. The fatal results in animals warns us to be cautious in the rapidity of injection; but in cholera the low conditions of the circulation warn us of a small quantity of blood, which instantly requires repair; but if the stream be too sudden and the quantity great, the salt solution may have the effect of paralyzing the heart or producing pulmonary œdema. Professor Gartner on this account recommends the introduction of half a litre every quarter of an hour. This may be considered a surgical operation, and requiring more care than the subcutaneous, but one that the practitioner should be prepared to meet in a cholera epidemic.

METHYLENE BLUE IN THE MALARIA OF CHILDREN.

In an elaborate article, CLEMENTE FERREIRA (*Bull. Génér. de Thérapeutique*, June 15, 1893), after summarizing the history of methylene blue, gives interesting details of twenty-one cases of malarial poisoning of children in which the drug gave excellent results. The author concludes as follows:

1. Methylene blue is an efficacious agent in the treatment of malarial poisoning in children.

2. The drug is of great service, especially in obstinate and prolonged cases which have resisted the action of other medicaments.

3. Its employment is likewise of benefit in young children suffering from the intermittent or remittent forms of the disease, unaccompanied by phenomena so serious as to place in immediate danger the life of the little patient. It may be added here that in those pernicious types of malaria which do not yield even to large doses of quinine, it is not wise to resort to the exclusive use of methylene blue; but to the administration of the latter drug may be associated the occasional injections of the bichlorhydrate of quinine, when the action becomes much more energetic and prompt.

4. Methylene blue is perfectly well borne by children; it produces in them neither vomiting nor diarrhœa, and the little patients take it easily, which is an advantage over quinine.

5. Methylene blue exercises a decided action on the malarial germs and on the paludal process of infection, proved by the fact that the characteristic bodies in the blood disappear, together with the phenomena of increased volume of liver and spleen.

6. The drug in question acts undoubtedly on the pyretic element, but the effects produced are far less pronounced than those caused by antipyrin. It is, therefore, a feeble antithermic and of no value in hyperthermias.

7. Methylene blue may be administered to children of all ages, without inconvenience, in varying doses, and according especially to the degree of obstinacy and resistance of the infection. The march of the disease and the appreciation of the effects produced are the chief guides, in the majority of cases, for the administration of the medicament. Its use must be continued for a few days after the disappearance of the fever and all other symptoms, in order to avoid relapses so common in the intermittent fever of children.

8. Methylene blue deserves to be largely employed in the treatment of malarial poisoning of children. Its efficacy has been demonstrated by instructive observations. In malarial regions it should be tried particularly to combat the infection, often rebellious to other useful medicaments and measures.

THE ACTIONS OF CHLORALOSE.

The actions of this medicament, contained in a recent work of MARAGLIANO, and presented to the Académie de Gênes, are briefly reviewed (*La Médecine Moderne; Les Nouveaux Remèdes*, June 24, 1893). The drug generally produces sleep in half an hour after its administration. The sleep is peaceful and destitute of dreamy visions. The sensibility to pain during sleep is modified by the size of the dose employed. The reflexes are increased. The pulse is not altered in any manner, and no effects are produced either on the temperature or the respiration. The digestive tract remains intact. Under the influence of chloralose the nervous symptoms manifested lead to the determination of latent neuropathies. The vascular phenomena caused by the drug are those of a vaso-motor character, dependent upon an action on the nervous mechanism. There is

produced a constriction of the peripheral vessels, this action being proportionate to the degree of the hypnotic effect caused by the agent. Chloralose can be administered in doses of 10 centigrammes, to be increased according to individual susceptibility, and until the desired effect is produced. It has no cumulative action. For females the doses must be comparatively small.

Morselli employed the medicament in twelve neurasthenic cases. Women were quite susceptible to the action of chloralose. To obtain a good hypnotic effect in neuropathies, it was found necessary to increase the dose rapidly,—from 25 to 50 centigrammes. The variability of action of the drug was extreme, but its alleged peculiarity of revealing latent neuropathies was not observed.

Mosso has experimented upon the lower animals with both chloralose and parachloralose. Contrary to the statements of Richet, he found the latter medicament quite active. It paralyzed frogs, but the reflexes remained intact or were even increased. In dogs, large doses of the agent produced a diaphragmatic respiration, and a primary increase, followed by a secondary diminution, in the rate of the pulse. The temperature was quickly lowered, but after awakening of the animal it went even above the normal. The blood-serum was colored with methæmoglobin, and hæmoglobin was found in the urine. Sensibility remained intact, and the reflexes were increased. The conductibility of the nerves was not affected, even late in the poisoning, neither was there any alteration in the electrical muscular contractility.

It is thought that these differences of opinion must be attributed to impurities of the medicament employed. The singular property of the drug, however, pointed out in these researches, as observed by P. Marie and confirmed by Maragliano, is that of "revealing (bringing into prominence) latent neuropathies." It may be said, with the latter author, that "chloralose has a great future, not only from a therapeutic point of view, but also as a powerful reagent of the nervous system."

CARBON DIOXIDE IN WHOOPING-COUGH.

A. Bergeon (*Lyon Médical*, June 25, 1893) calls attention to the fact that since 1887 he has treated whooping-cough successfully with rectal injections of carbon dioxide. He relates the case of his own child, three years of age, in whom the treatment gave the most satisfactory results. The author is supported in his method by the experience of Girord, who has observed the good effects of the gas in the disease under consideration in his own case as well as in those of his two children, a boy and a girl, seven and three years of age respectively. He confirms in every point the observations of Bergeon. The method of this latter investigator is as follows: Immediately after an access of the malady, he administers, in the form of a rectal injection, about two litres of carbon dioxide mixed with a few centigrammes only of pyridin. The child can take food after the operation, since this causes no disturbances of the digestive tract. The injections can be repeated after each access of the cough, and even at night, with intervals of four hours. The author has performed the operation in very young children five and six times in the twenty-four hours. He affirms that the worst cases yield to the treatment in a week at most; exceptionally does the disease enter in its second week.

ABOUT BOILED MILK.

In a recent communication to the Société de Médecine de Lyon on the above subject, Crolas (*Lyon Médical*, June 25, 1893) concludes,—

1. That the process of boiling the milk relieves this article of food of small quantities of butter, which, mixed with albumin, is found in the skin that forms over the milk on cooling.

2. That boiling has no action whatever on the caseine or the lactose, these principles remaining the same after as before the boiling.

3. That boiling increases the quantity of the soluble phosphates, this appearing to show that boiled milk contains a larger amount of phosphoric acid ready for assimilation.

Crolas, therefore, believes that boiled milk, as an article of food, is equivalent, if not superior, to non-boiled milk.

INJECTIONS OF CAMPHORATED NAPHTHOL IN THE TREATMENT OF TUBERCULAR ADENITIS.

À propos of a new communication by Reboul in regard to seven cases of tubercular adenitis in which excellent results were obtained by the use of the above medicament, Nélaton reports another similar case to the Société de Chirurgie (*L'Union Médicale*, July 1, 1893), in which the same good effects were observed from the injections of camphorated naphthol. The patient was suffering from a generalized tubercular adenitis on both sides of the neck. The injections of the camphorated naphthol brought

about an almost complete cure, and after a year's treatment only traces of the diseased glands could be observed.

THE CARBONATE OF BEECH-CREOSOTE IN THE TREATMENT OF TUBERCULOSIS, AND ESPECIALLY OF PULMONARY PHTHISIS.

In an interesting article, EDMOND CHAUMIER (*Journ. des Sciences Médicale de Lille*, June 9, 1893; *Gazette Médicale de Paris*, July 1, 1893) details eight cases of tubercular disease in which the most excellent results were obtained from the employment of the carbonate of beech-creosote. The medicament has a slight odor of creosote, and an insipid, oily taste, resembling that of tar. The new preparation is insoluble in water, but soluble in absolute alcohol, and contains ninety-four per cent. of creosote. Patients take the drug easily. It may be administered in capsules or in emulsion. For children, the dose is from 1 to 6 grammes; for adults, 10 to 15 grammes. It can, however, be given in larger amounts.

The carbonate of creosote is eliminated partly by the urine. In most cases this liquid becomes of a brownish, smoky, or greenish-black color, and acquires the odor of the drug. In one case the change of color in the urine was observed on the first day of the administration of the medicament. The remedy can also be detected in the breath, a proof that it is eliminated also by the lungs. The carbonate of creosote produces no untoward effects, such as irritation of the stomach or the intestines. It does not provoke diarrhœa generally, although many patients complained of this trouble during the treatment.

Among the first good effects of the creosote carbonate are an improvement of the appetite and an increase of the bodily strength. These effects are followed by a diminution of the cough, and later of the pulmonary lesions. *Pari passu* with these good results there occurs an increase in bodily weight often quite marked. Thus, for instance, a girl, six years of age, who, from the 4th of February to the 4th of August, had only gained two pounds, obtained, from the 4th of August to the 5th of September, four pounds under treatment by the carbonate of creosote. In one month she had gained more than a healthy child in a year. The girl practically recovered shortly afterwards. Almost all traces of the lesion had disappeared; she had not coughed by the beginning of November, and by the 14th of the following January she had gained eight pounds,—that is, almost three times as much as a healthy girl six and a half years of age. Another girl, twenty years of age, gained twelve pounds from the 14th of November to the 21st of January; and a third one, fifteen years of age, gained seven pounds from the 20th of August to the 18th of October,—that is, in the course of two months. In this last case the pulmonary lesions disappeared completely. A very rapid amelioration was noticed in one case in which the pulmonary hemorrhage became so serious as to threaten the life of the patient. Two cases of acute pleurisy are described. In one of them the effusion disappeared by the seventh day; in the other case by the thirteenth day. This last case was that of a child thirteen years of age.

According to the author, the administration of the new remedy must be conjoined with the application of hygienic measures, otherwise the use of the drug is apt to be attended with utter failure. Good ventilation and nutritive food are indispensable in these cases. The carbonate is destined to replace the creosote itself in the treatment of tuberculosis. It may be added that, since the writing of the article here abstracted, Chaumier has also employed the carbonate of creosote in hypodermic injections, in doses of 5 cubic centimetres. These injections, the author affirms, are not painful.

THE PROPERTIES AND ACTIONS OF THE METHYLAMINES.

COMBEMALE (*Bull. Génér. de Thérapeutique*, March 30 and April 15, 1893) has published an experimental study of the actions of the methylamines, from which the following abstracts are taken:

1. *Monomethylamine.*—This body is represented by the formula of $NH(CH_3)$. It is a gas which at a few degrees below zero liquefies, has an ammoniacal odor, and a strong alkaline reaction. Monomethylamine is the most soluble of known gases. At 12° a volume of water dissolves 1150 volumes of the gas; at 25°, 960. The aqueous solution possesses the odor of the gas, this disappearing entirely on boiling the solution. From experiments performed on six dogs and a guinea-pig interesting results were obtained. The drug was administered once only by the stomach; it was usually given hypodermically. The fatal dose was found to vary from 10 to 15 cubic centimetres per kilogramme of the body-weight. Death took place, in these instances, in from twenty-four to forty-eight hours, and was usually preceded by hæmaturia. Five centigrammes of monomethylamine

per kilogramme of the body-weight proved fatal to a dog, but this animal had been used for previous similar experiments. Excessive congestion of the kidneys and the liver (less marked in the latter) was the most constant post-mortem lesion found. Hemorrhagic points were noticed all along the small intestine, especially in the neighborhood of Peyer's patches. The valves of the heart were reddened as if an endocarditis had previously existed; infarcts were also observed in the lungs. The brain presented a pale appearance. The following conclusions are reached: 1. Locally, monomethylamine is a powerful irritant, producing tissue necrosis. 2. On the general economy the drug produces bloody extravasations in the kidneys, liver, heart, and intestines, this general action being accompanied by variations of the central temperature, and more or less by sialorrhœa and albuminuria. To obtain the local effects described, a 1-to-250 solution is required; for the general action, the dose should be below 10 centigrammes per kilogramme of the body-weight; a higher quantity is sure to cause death.

2. *Dimethylamine.*—The formula of this substance is given as $NH(CH_3)2$. It is also a gas, readily soluble in water, of a strong ammoniacal odor, and exceedingly alkaline in reaction. At a low temperature it liquefies, and its general properties are similar to those of monomethylamine. The results of a series of experiments led the author to formulate these conclusions: 1. Given by the stomach, in doses of from 5 to 10 centigrammes per kilogramme of the body-weight, or in solutions of the strength of 1 to 300 or 1 to 1000, dimethylamine produces no marked effects. 2. Hypodermically, (*a*) the drug acts as a powerful caustic, causing marked scars, even in solutions of the strength of 1 to 200; (*b*) the minimum fatal dose is 20 centigrammes per kilogramme of the body-weight; (*c*) the initial fall and the subsequent rise of the bodily temperature are neither constant phenomena nor proportional to the dose employed; (*d*) the most constant effect is an increase of the salivary secretion and of the normal alkalinity of the saliva; (*e*) dimethylamine is partly eliminated by the kidneys, the irritant substance excreted bringing about a congestion of these organs. The latter phenomenon is often accompanied by an intense hæmaturia or by albuminuria.

3. *Trimethylamine.*—The formula of this substance is set down as $N(CH_3)3$. It is a gas at ordinary temperatures, but below these it also becomes a liquid. The odor of trimethylamine resembles that of ammonia and putrid fish; it has a decided alkaline reaction, and is readily soluble in water and alcohol. Trimethylamine is also found in the vegetable kingdom, particularly in the leaves of the *Chenopodium vulvaria*, in the flowers of *Cratægus oxyacantha*, in ergot, *Secale cornutum*, and in *Sorbus aucuparia*. The drug has been obtained similarly from the animal kingdom, especially from the herring, cod-liver oil, the blood and urine of man, and from animal oil. Its action has been studied by other investigators; but, according to Combemale, the physiological effects of trimethylamine may be summed up as follows: 1. No matter how ingested, the most constant effect of the drug is the immediate hypersecretion of saliva, accompanied by an increase of the alkalinity of this fluid. Sometimes the secretions of the nasal mucous membrane and of the lachrymal gland are also increased. Another common effect is albuminuria, this appearing a few days after the administration of the drug. 2. Injected hypodermically in aqueous solution of the strength of 1 to 100, trimethylamine acts as a powerful caustic, producing ulcerations that heal with difficulty. 3. In solutions of the strength of 1 to 200, or in doses of about 3 centigrammes per kilogramme of the body-weight, trimethylamine lowers the temperature. This hypothermia, which can also be produced when the drug is given by the stomach in doses from three to seven times as large, is not constant. 4. In all instances, trimethylamine, in higher doses than 2 centigrammes per kilogramme of the body-weight, causes an increase in the pulse-rate.

A comparative study of the actions of the three methylamines justifies the author in concluding that *the toxic, local, and general actions of these bodies are less marked in proportion to the number of the methyl radicals found in their respective chemical formula.* The *rôle* played by the number of radicals in the intensity of the physiological effects of the methylamines has been overlooked and deserves serious consideration.

LOCAL APPLICATION PER RECTUM OF ALOIN, CATHARTIC ACID, COLOCYNTHIN, AND CITRULLIN AS LAXATIVES.

KOHLSTOCK (translated from *Pharmaceutische Post*, p. 1249, 1892) has instituted experiments in the clinic of Professor Senator, at Berlin, respecting the subcutaneous and rectal employment of cathartics. The investigations were confined to four vegetable substances,—aloin,

cathartic acid from senna, pure colocynthin, and citrullin. Subcutaneous introduction proved extremely painful. The author then essayed with happier results the rectal application of the substances mentioned.

The medicaments were dissolved in the appropriate media, and injected into the bowel with the aid of a glass syringe containing ten cubic centimetres. Aloin and cathartic acid proved to be adapted to the milder cases, colocynthin and citrullin to habitual constipation. Aloin is the mildest, citrullin the most energetic agent. The aloin was first applied in a glycerin solution. The quantities of glycerin thus injected simultaneously were, however, too slight to account for the cathartic action as due to the glycerin. The action, moreover, persisted when subsequently, in accordance with H. Meyer's suggestion, the aloin was dissolved in formamide. The solution employed was of the following composition:

Aloin, gr. xv;
Formamide, ʒii.

A dose of 4 to 5 grains is sufficient to bring about certain results in all cases of mild constipation. Cathartic acid yields certain results in doses of 6 grains. It is administered as follows:

Acid. cathartinic. e senna, gr. iii;
Aq. dest., gr. vii;
Natr. bicarb. ad react. alkalin., q. s.

For more stubborn and habitual constipation, colocynthin, in doses of .01 to .04 grain, as well as citrullin, should come into requisition, the latter acting vigorously in doses of .02 grain even in aggravated constipation. Prescribe—

Colocynthin, gr. i;
Alcohol, gr. xii;
Glycerin, gr. xii.

Or,

Citrullin, gr. ii;
Alcohol, gr. xlix;
Glycerin, gr. xlix.

The following properties are common to all these agents when applied per rectum: On the bowel itself they do not produce the slightest irritation, hence the patient is spared the torturing tenesmus which not seldom follows the glycerin clyster. In most cases a passage ensues pleasantly; severe abdominal pains are very rare. The evacuations are very copious, and in this respect materially surpass those produced by injections of glycerin, for glycerin causes depletion of only the lowest portions of the bowel. The agents in question leave behind no tendency to constipation. On prolonged use, indeed, a certain habituation supervenes. At such times, however, a very slight increase of dose suffices. Disturbing collateral effects were not perceived. The urine always remained normal.—*Les Nouveaux Remèdes.*

EXTERNAL TREATMENT OF DIPHTHERIA.

In *L'Union Médicale* for June 3, 1893, SIMON, in a clinical article, announces his success in the external treatment of diphtheria. He employs to the area which is involved the following topical application:

℞ Salicylic acid, gr. xv;
Infusion of eucalyptus,
Glycerin, of each, ʒiss;
Alcohol, enough to make a solution.

After this has been thoroughly applied to the affected area he paints the part with a solution of perchloride of iron and glycerin in equal parts. Along with this treatment he also institutes irrigation of the mouth and nasal cavities, using in each instance boric acid and water, or a 1-to-100 solution of carbolic acid and water. He also thinks it useful to employ the vapor of a decoction of eucalyptus leaves or atomization of thymol and water. Where there are fissures and cracks of the lips or gums, or if a pseudo-membranous inflammation has passed by, he obtains rapid healing through the use of the nitrate-of-silver stick applied daily lightly to the surface. If cutaneous inflammations follow diphtheritic inflammation, he employs tincture of iodine or an alkaline solution of iodoform.

PRESCRIPTION FOR INFANTILE CONVULSIONS.

SIMON advises the following treatment in infantile convulsions:

First empty the alimentary canal by the use of a laxative and by the employment of emesis. Should the attacks then continue, inhalations of chloroform or ether should be given on a handkerchief, and a teaspoonful of the following mixture should be given by the mouth and rectum every three-quarters of an hour:

℞ Hydrate of chloral,
Bromide of potassium, of each, gr. xv;
Syrup of codeine, gtt. x;
Tincture of musk,
Tincture of aconite, of each, gtt. x;
Orange-flower water, ʒiii.

In case the attack is severe and prolonged, a hot bath should be advised, and blisters applied to the epigastrium and back of the neck. Care should be taken that antiseptic precautions are carried out in the production of the blisters.—*L'Union Médicale.*

DIGITOXINE IN HEART-DISEASE.

According to *La Médecine Moderne* for June 7, 1893, MASIUS has highly recommended to the Royal Academy of Medicine in Brussels the employment of digitoxine in cardiac therapeutics. The dose which he recommends is $\frac{1}{100}$ of a grain once or twice daily. Under these circumstances the ordinary effects of digitalis are obtained without the disturbance of the alimentary canal.

Van Aubel states that he has found that in doses of $\frac{1}{100}$ of a grain, when injected subcutaneously, it does not produce inflammation. For hypodermic injection in man he recommends the following:

℞ Digitoxine, gr. ½;
Chloroform, gtt. xxx;
Alcohol, ʒvi;
Distilled water, ʒii.

This may be used in eighty subcutaneous injections. Digitoxine, when employed in this way, should be absolutely pure and crystalline. The authors believe that by digitoxine we make up the greater part of the active principle of most of the digitalines of commerce. Another advantage in digitoxine is that it acts rapidly, and can be employed where the slow action of digitalis is objectionable.

THE TREATMENT OF HEPATIC COLIC.

GRASSET is a firm believer in the administration of olive oil in the treatment of acute and subacute hepatic colic. In the acute form the duty of the physician is to relieve the pain. For this purpose may be employed (1) a hot bath, which shall last from half an hour to an hour and a half; (2) he may administer every hour or every half hour a teaspoonful of the following mixture:

℞ Chloroform-water, ʒv;
Syrup of orange-flowers, ʒv.

In cases where there is vomiting, he advises hypodermic injection of morphine, and by the mouth administers frozen milk or frozen bouillon. When the crisis of the pain is most violent, if the stomach be tolerant, he advises ingestion of small quantities of olive oil every quarter of an hour until half a pint has been taken. The oil may be rendered aromatic by the use of the oil of peppermint. An injection also should be given composed of two drachms of infusion of senna and half an ounce of the sulphate of sodium.

In the treatment of the subacute form, which is more prolonged, of course, he advises (1) ingestion every morning of a wineglassful of aromatized olive oil; (2) every night a hot bath; and (3) every day four doses of from 4 to 10 drops of tincture of boldo; (4) morning and night he orders the administration of the following laxative pill:

℞ Extract of belladonna,
Euonymin,
Pulverized belladonna-leaves, of each, gr. ss.

In some cases it is well to supplant the euonymin with podophyllin. (5) Every two hours he administers a glass of milk, and in addition adds to this two tablespoonfuls of Vichy water. In other cases where a laxative effect is desired, sulphate of magnesia is useful.—*L'Union Médicale*, June 3, 1893.

TREATMENT OF CANCER OF THE STOMACH.

In a clinical lecture published in *L'Union Médicale* for June 8, 1893, PETER recommends the following treatment in cases of gastric carcinoma. After dividing these cases into latent, obscure, and evident carcinoma, he recommends that the diet shall consist of milk, or any nutrient liquid which is tolerated, such as kefir; he also believes that rectal injections of peptonized foods are of value. For the pain he believes that the internal administration of opium and the application of irritation externally will often give relief. For the loss of appetite and constipation, which are very frequently associated, he employs tincture of rhubarb, 1 drachm; tincture of nux vomica, 30 drops; and of this mixture gives 10 to 30 drops after each meal.

If pain follows eating, he adds to this prescription some laudanum. In all cases of gastric carcinoma there is a decrease in the quantity of hydrochloric acid. He thinks it well, for the purpose of aiding digestion and decreasing pain, to prescribe some such mixture as follows:

℞ Syrup of lemon, ʒii;
Hydrochloric acid, gtt. x.
Sig.—A dessertspoonful after meals.

If, for any reason, it is believed that there is a condition of hyperacidity of the stomach, then bicarbonate of sodium may be administered.

THE USE OF CREOSOTE BY RECTAL INJECTION.

The employment of creosote by rectal injection is often advisable, but the difficulty of its administration in this form is that it has to be given in some animal oil, such as cod-liver or neat's-foot oil, and that it is almost impossible to emulsify it properly unless some gummy substance is added. These difficulties have prevented the rectal administration of creosote becoming generally resorted to.

CARLOS has made, however, a very ingenious administration of creosote by the use of saponine of Panama wood. He employs a tincture of Panama wood, and prepares the solution as follows:

℞ Distilled water, ℥ii;
Tincture of Panama wood, ℥iii;
Pure creosote, ʒiiss.

A tablespoonful of this mixture is added to cold water and heated, when it immediately forms a limpid liquid, which is readily administered by injection. This injection, it is also stated, is readily retained and absorbed by the mucous membrane.—*La Médecine Moderne*, June 7, 1893.

THE AFTER-TREATMENT OF CATARACT EXTRACTION.

DR. WILLIAM OLIVER MOORE (*Medical News*, September 2, 1893), on the completion of the operation of extraction of cataract, carefully washes the cornea and conjunctival cul-de-sac with a warm boric-acid solution, in order that all secretions or coagula may be removed. A solution of mercuric chloride (1 to 8000) may also be used. The eyelids should then be gently closed, and over them placed a small square of old linen, either dry or covered with oleum petrolei, cold cream, or the like. When the skin is delicate, the oiled cloth is preferable. Small pads of absorbent cotton are now placed over the oiled cloths sufficient in quantity to fill the space between the eyeball and the forehead, so that the pressure of the bandage will be uniform and gentle. This cotton may be medicated or not, as desired by the surgeon. Over this dressing is placed the roller bandage. This is made of fine flannel if it is the winter season, or of cheese-cloth if it is summer. It should be from one and a half to two inches wide and about three yards in length, applied in the form of the well-known figure 8. As a rule, only one pin is required to fasten the bandage, and this of the ordinary kind. He has never seen a bandage properly applied when one pin was not sufficient to hold it in position, except in the case of women having long hair. It is his custom in such cases, besides using the pin as mentioned, either to fasten the bandage by means of a hair-pin passed through it and into the back of the hair, or to put on an old-fashioned night-cap over the bandage, which keeps it firmly in place. He is fully aware that the bandage is considered by many surgeons as unnecessary, and that bands of water-plaster or any adhesive strap over the eyelids are sufficient. When the bandage is applied, the patient, if in the operating-chair or upon the table, should be gently led to bed, and when in it should be allowed to assume any position which is comfortable and easy. He considers the practice of keeping cataract patients in bed for the first twenty-four hours cruel and unnecessary. If the patient is restless, the sitting posture may be assumed. He thinks that hypostatic congestion of the lungs may be set up by rigid enforcement of rest on the back.

It is his custom to allow the bandage to remain on both eyes for four hours, unless there is pain, when it is immediately removed, the eyelids bathed gently with a solution of mercuric chloride (1 to 10,000), and the lids cautiously opened. When no pain occurs after the operation and all is quiet at the end of four days, he removes the bandage for the first time and inspects the eyes, first having washed the lids with the mercuric-chloride solution. He thinks the room may be darkened slightly, but that there is no advantage in keeping it absolutely black. If, upon inspecting the eye, no undue redness is noticed, and there is no iritis, a mydriatic need not be used. If, on the other hand, there is any reaction, atropine is instilled twice a day. After the fourth day the bandage need not be reapplied to the unaffected eye, but the eye should be shielded with a shade. On the eighth day the bandage may be removed entirely. In cases in which pain occurs, and in those in which, on removing the dressing, pus is found on the linen pad, purulent infection is suspected. If the wound is sloughing, the eyes are carefully cleansed with bichloride-of-mercury solution and the corneal wound cauterized, hot water applications being made every two hours and atropine solution instilled.

THE TREATMENT OF BLENNORRHŒA NEONATORUM.

Dr. Boerne Bettman (*Journal of the American Medical Association*, August 12, 1893) writes concerning the treatment of blennorrhœa of new-born infants, the main object of his paper being to denounce the idea which prevails that a two-per-cent. solution of nitrate of silver is specific for all cases of this complaint. He considers that the treatment of the disease does not only consist in using nitrate of silver, but in knowing when and how to use it. The mild form of the disease is readily controlled by cold applications to the lids, and in the second stage by the instillation of a saturated solution of boracic acid every two hours and the daily application to the everted lids and cul-de-sac of a one- or two-per-cent. solution of silver nitrate.

The virulent form requires energetic measures. During the first stage caustics must not be employed. The parts should be cleansed every hour or two with a solution of bichloride of mercury (1 to 5000) and a saturated solution of boric acid. It is only when the purulent secretion is free that the nitrate of silver is indicated. If the strength of one or two per cent. does not check the discharge, he gradually increases it, and has used it as high as fifteen per cent. As soon as the swelling visibly subsides and the discharge decreases he uses hot fomentations. If there is ulceration, atropine is instilled, and if the ulcer is progressive in character, it is touched with carbolic acid or the actual cautery.

EXTRACTION OF PART OF THE CAPSULE AS AN OPERATIVE PROCEDURE IN CERTAIN CASES OF SECONDARY CATARACT.

John Dunn (*Archives of Ophthalmology*, July, 1893) was consulted by a patient upon whose eye Förster's operation for ripening had been done, followed by extraction and capsulotomy. The resulting vision was bare perception of light. Examination of the eye showed a well-knit corneal extraction scar, a complete upward coloboma of iris, whose edge was everywhere, except perhaps centrally below, adherent to a thick capsule in which there was no opening. In the centre of the coloboma below, viewed from above, there was apparently communication between the anterior and posterior chambers through an opening one-half to one millimetre in diameter. The thickened capsule, however, extended below the iris edge, so that no light entered the eye through this opening.

Dunn considered that a further needle operation was contraindicated, and that the best means of obtaining vision was in section and removal of a square of the capsule. This was done as follows: A sharp capsule-knife was forced through the cornea near its upper edge, and then through the anterior chamber to the iris border below. Two parallel cuts were then made in the capsule from below upward, and these cuts then joined below. The lines of incision were more or less irregular, and some tearing, rather than cutting, had to be done. The result was a capsular flap attached above. No manipulation of this flap could make it give a clear pupillary space. With a small cataract-knife, a corneal section three millimetres in length was then made along the upper corneal edge. A pair of iris forceps was next introduced through this wound and the floating flap was seized, with the intention of cutting it off with a pair of scissors should there be any traction on the iris. It, however, came away without trouble, the escape of vitreous not being more than a drop. The eye healed without complication, and vision was equal to one-sixth. He thinks the operation of capsulectomy justifiable not only in cases like the one reported, where the iris is everywhere adherent, so far as can be seen, to a thickened capsule, but also in those cases where, following extraction, the capsule is much thickened, the iris remaining free.

THE USE OF GRAFTS OF SKIN AND OF MUCOUS MEMBRANE IN THE TREATMENT OF DISEASES OF THE EYELASHES AND OF THE LIDS.

Dr. H. W. Woodruff (*Annals of Ophthalmology and Otology*, July, 1893) writes as follows: Since the investigations of Thiersch and others in demonstrating the vitality of grafts of skin, his method has become an essential feature in modern surgery, especially in plastic operations about the face.

The oculist is often confronted with deformities of the eyelashes and of the lids, which may be relieved by the judicious use of these grafts.

For pronounced forms of entropion, the usual methods of operating, as those of Hotz, Arlt, and others, generally suffice; but we often have the condition of partial entropion or trichiasis and distichiasis where there is no incurvation of the tarsus, but a failure of the lashes to grow in a proper direction, or the presence of more than one row.

These lashes may, of course, be removed by

epilation or by electrolysis, methods which experience has shown are not uniformly successful.

Many use strips of skin, splitting the border of the lid and filling the gap with the graft, and this method generally has the effect of turning out the lid border and removing the offending lashes from the cornea. But skin is not mucous membrane, and never becomes such, and very often a graft of skin will keep up the irritation of the cornea even if no hairs are present, and it is not always possible to obtain a skin-graft entirely free from hairs.

In all cases where only a small strip a few millimetres in width is needed, the mucous surface of the lower lip furnishes a good locality for such a graft. The mucous membrane graft, if properly applied, is non-irritating.

The general methods are the same as in all plastic operations.

The essentials to success are the same as in the treatment of any wound: absolute asepsis, complete stasis, approximation of the parts, and rest.

In eight cases in which this method was used all were successful, but in two the effect was not sufficient, owing to the small size of the grafts.

In securing asepsis the usual methods may be employed, not allowing a stronger solution than 1 to 5000 of the bichloride of mercury to enter the eye.

The incision is made along the border of the lid; care must be taken to have it behind all the cilia. It must be made deep and of sufficient length. The lid clamp may then be placed on the lid, and a strip of mucous membrane, slightly larger in all dimensions than the incision, is excised, taking care not to remove submucous tissue with it. This strip is placed in a warm alkaline solution until all hemorrhage has been checked about the lid.

Continuous washing with the bichloride solution, with pressure with a pledget of cotton, will be sufficient. The graft is then accurately approximated, taking care to remove all clots. Lids are carefully closed, and both eyes bandaged. It is not necessary nor advisable to use sutures, as with proper care the graft will retain its position. Bandage may be removed in about three days.

Dr. Woodruff refers to a case of skin transplantation in a man aged seventy-one. He was admitted to the Illinois Charitable Eye and Ear Infirmary with an extensive ectropion of the right lower lid, of two years' duration, due to relaxation of the skin with spasm of the orbicularis muscle. The general health of the patient was good. The lid itself was somewhat shrunken and could not be raised to its normal position.

An incision was made parallel with the border of the lid and the upper flap drawn upward. This made a space about thirty millimetres long and about eighteen millimetres wide. The flap was taken from the inner surface of the arm, about six millimetres larger in all dimensions than the space to be filled. After removing all underlying tissue, it was placed in a warm boric-acid solution until all hemorrhage had ceased. The flap was then placed in position and, where necessary, trimmed with scissors so that it approximated all parts accurately. About six fine sutures were used to hold it in place. A moist bichloride dressing was applied and both eyes closed with a bandage. The bandage was removed on the third day and sutures on the fifth. There was some suppuration of the nasal side of the flap, and a dressing of iodoform was used.

In two weeks the bandage was left off and a solution of bichloride of mercury (1 to 5000) used as a wash three times a day. The patient was discharged in four weeks from the time of operation. The graft had shrunken somewhat, but there was no return of the ectropion, and the conjunctivitis, which had been present before, was entirely cured.

FORMULAS FOR CONJUNCTIVAL INFLAMMATION.

Dr. Edward Jackson (*Philadelphia Polyclinic*, August 15, 1893) writes as follows concerning solutions suited to conjunctival inflammations: Among ophthalmic surgeons, solutions of boric acid, with or without the addition of a certain amount of borax, are in constant use for inflammation or irritation of the conjunctiva. The beneficial influence exerted by them is strictly confined to the conjunctiva; in inflammation of the deeper structures of the eye they are useless. A common proportion is—

> Boric acid, 3 parts (gr. xii);
> Distilled water, 100 parts (f℥i).

In water at ordinary temperatures, boric acid is only soluble to the extent of about four per cent., and to prevent any deposit, it is necessary to prescribe less than would make a saturated solution. As far as any excess of action upon the conjunctiva is concerned, it may even be applied in the form of powder, provided the powder is sufficiently fine (impalpable), without provoking irritation.

Where borax is added, it may be in the following proportion:

Sodium biborate, 1 part (gr. iv);
Boric acid, 3 parts (gr. xii);
Distilled water, 100 parts (f℥i).

Borax is much more freely soluble in water than in boric acid, but cannot be used in anything like saturated solutions without causing severe conjunctival irritation.

The addition of the sodium salt to boric-acid solution renders the solution very decidedly alkaline. Such an addition increases the cleansing power of the solution and renders it more efficient as an antiphlogistic in cases in which there is any appreciable conjunctival discharge.

These solutions are often spoken of as antiseptics, but they have very little reason to be so called. For any antiseptic effect, probably their most important ingredient—and this may be true of many other so-called antiseptic solutions—is the water they contain.

They are simply cleansing and soothing in their action, and may be used in all cases of conjunctival inflammation with the greatest freedom and without danger of injury. For slight hyperæmia or irritation, indicated by burning, itching, or smarting of the eyes, 5 or 10 drops is usually ordered to be used three or four times per day. Where there is marked purulent discharge, the solution is to be used by the drachm or half-ounce every hour, or so often as is necessary to keep the conjunctiva thoroughly cleansed with it.

The application of such a solution is not followed by any smarting, burning, or increased pain of any kind, but usually by a very notable relief from such sensations. The solution of boric acid is on many accounts an admirable placebo, and it is to be borne in mind when a placebo is required, yet it has a positive soothing and cleansing action.

It answers well as a vehicle for the mydriatics or myotics, although it has little or no power to prevent the growth of the low vegetable forms that are liable to infest such solutions when kept long at ordinary temperatures.

EPIPHORA OF INTRANASAL ORIGIN.

Dr. Walter J. Freeman (*Philadelphia Polyclinic*, July 15, 1893) reports a series of cases in which he desires to emphasize the importance of intranasal treatment for the cure of epiphora. These cases consisted of an overflow of tears caused by hypertrophy of the inferior turbinals, vaso-paretic condition of both inferior turbinals, myxomatous degeneration of the anterior end of the right inferior turbinal, deviation of the septum, and synechiæ between the inferior turbinals and the floor of the internal fossa. They were all cured or relieved by intranasal treatment suited to the lesion present. In closing, Dr. Freeman refers to the ease and certainty with which some forms of epiphora are permanently relieved by intranasal surgery, although he sounds a note of warning lest the single symptom of lachrymation be regarded as a signal for instituting nasal treatment without duly weighing coexisting ocular troubles. He very properly refers to the fact that the presence of pus in the lachrymal sac indicates almost unerringly the presence of stricture, and that although the rhinologist can do much to aid the ophthalmologist, such a case is, in other respects, beyond his province.

QUININE BLINDNESS.

Dr. Kaspar Pischl (*Medical News*, July 29, 1893) reports a case of quinine blindness in a man, aged forty, who during an attack of malaria had taken three 10-grain doses of phenacetin and during twenty-four hours 30 grains of quinine. The next morning he awoke totally blind. When examined by Pischl, more than a month after the ingestion of the quinine, his central vision was not far from normal, but his field of vision contracted to a very small area, the optic nerves white, and the vessels diminished in calibre. Marked improvement occurred under the influence of hypodermic injections of strychnine and the use of the constant current, three milliampères, the anode over the eye and the cathode on the neck, for fifteen minutes daily.

SHOULD A MYDRIATIC BE USED, AS A RULE, IN REFRACTIVE CASES?

Dr. J. E. Minney (*Ophthalmic Record*, August, 1893) instituted an inquiry to learn the practice of oculists respecting the frequency with which they used a mydriatic and the kind employed, together with reasons for their practice and remarks on the subject. With this end in view, he addressed letters to twenty-two ophthalmic surgeons in the United States, from whom he received replies. The synopsis of the answers is as follows: Five of the surgeons consulted use a mydriatic in all cases of refraction; two in ninety per cent. or over of their cases; three in twenty-five per cent.; six sel-

dom use it, and six do not use it as a routine practice. Five of the surgeons employ atropine in seventy-five to one hundred per cent. of their cases; seven in sixty-five to one hundred per cent. use homatropine; three do not use homatropine; one uses homatropine and cocaine in seventy-five per cent.; two use cocaine in twenty to fifty per cent. of their cases; and one uses duboisine in some cases. With reference to the kind of refraction, it was noted that one used cocaine in ninety per cent. of presbyopia, and one homatropine and cocaine in ten to twenty per cent. of hypermetropia, while others do not use a mydriatic at all in such cases. It was further developed that a mydriatic was used more in hypermetropia and astigmatism than in myopia. In the practice of Dr. Minney atropine is used, but not as a routine practice.

AMERICAN CATHETERS AND BOUGIES.

GOULEY (*New York Medical Journal*, vol. lviii., No. 4) states that the properties of good web catheters may be summed up as follows:

1. They are thoroughly, but not too thickly, coated with varnish, inside as well as outside, and highly polished; the varnish is pliable, not apt to crack, and resists the action of moist heat up to 212° F.

2. In length they do not exceed thirty-three centimetres (about thirteen inches).

3. In diameter they vary from two to nine millimetres.

4. The distal extremity of their single oval eye is one centimetre from the point, which is smooth and rounded; this eye, in curved, elbowed, and double-elbowed catheters, is generally lateral, but in some of these instruments the eye is superior, corresponding to the concavity of the bend, and in other cases the eye is omitted, the catheter being open at both ends, or, in addition to the eye, the vesical end is open for catheterism upon a whalebone conductor.

5. Good web catheters are firm but pliable, never rigid, from the proximal to the distal end; a web catheter with a rigid vesical extremity is a dangerous instrument, liable to cause false passages in the deeper regions of the urethra.

6. The form of the vesical extremity is in accord with its intended uses; straight web catheters are not so safely and easily used as the curved, elbowed, or double-elbowed, the curved form being the most easily introduced into strictured urethræ and in the majority of cases of enlargement of the prostate.

7. The tensile strength of the different qualities of web catheters was ascertained by experiment to be as follows: The breaking strain of an English commercial catheter was forty-two pounds, the breaking strain of an American commercial catheter was fifty-four pounds, the breaking strain of an American lisle-thread catheter was fifty-six pounds, the breaking strain of an American silken-linen catheter was sixty pounds, the breaking strain of an English silk-web catheter was eighty-five pounds, and an American silk-web catheter of best quality was then tested to one hundred and fifteen pounds without breaking, but the varnish was stripped off at each end.

When it is necessary to retain a catheter in the urethra and bladder, the physician should select one which has not been too thickly coated with varnish. The highest grade of catheter is not always the best for this purpose, because in the course of twenty-four hours the urine filters through the internal wall of the catheter, the silk webbing is saturated, swells irregularly, and uplifts here and there the coating of varnish, which soon scales off, while the lisle-thread, silken-linen, and those silk catheters with thin external coating resist longer the action of the urine, and do not lose their smoothness after being retained forty-eight hours in the bladder. If, however, the interior of all web catheters were thoroughly varnished, and thus rendered impervious to moisture, there would be no irregular uplifting of the surface and no scaling.

The American commercial catheters have lately been much improved in quality, and they may be found very useful in hospital as well as in private practice. Their cost is little as compared with that of the higher grades. A catheter of this kind may be used for a single day and thrown away, or may be repeatedly boiled without injury, and used as long as the surface of the instrument retains its smoothness. These improved instruments are known as "ten-cent catheters."

No catheter whose surface is fissured or otherwise roughened should be passed into the human urethra, because it would not only irritate this canal, but convey therein septic germs. For general use, physicians will find it advantageous to purchase the higher grades of web catheters, because, with proper care, they last long and retain their suppleness and smoothness. After having used an American silk-web three hundred times, its surface was found to be as smooth as at the beginning. The instrument was then retired from active service to be preserved as an illustration of the excellence of

home manufacture. Another American silk catheter was used twelve hundred times by a patient, and set aside only because its surface had become irregular, although it was not cracked.

It is proper to make a few suggestions respecting the kind of care web and soft-rubber catheters require to render their employment safe to patients and easy to physicians:

1. All web catheters should be kept at full length and never coiled; otherwise the varnish will surely crack.

2. Web catheters should be loosely wrapped in dry antiseptic gauze and preserved in tightly-closed metal cases until wanted for use. After they have been used they should be carefully cleansed, thoroughly dried inside and outside, and then replaced in the gauze and case; or they may be carried in hollow walking-sticks.

3. Soft-rubber catheters should be kept at full length, never coiled, and should be wrapped in moist antiseptic gauze and preserved in tightly-corked glass tubes, capable of containing three or four catheters, because exposure to the air leads to rapid oxidation, which causes the instruments to become hard and brittle.

4. Before using a rubber or web catheter it should be dipped for a minute in a one-per-cent. carbolic-acid solution, but not longer, as carbolic acid, even in such a weak solution, acts injuriously upon the varnish of web catheters as well as upon rubber catheters by prolonged contact.

5. Before using a web catheter it should be slightly warmed by friction in the hands and by a momentary immersion in warm one-per-cent. carbolic-acid solution to prevent cracking of the varnish, particularly during cold weather.

6. Web and rubber catheters are much injured by fats of all kinds, by glycerin, by saliva, and by vaseline, which, however, seems to be the least hurtful of these lubricants. If used at all, it should be in the smallest quantity,—just enough to very thinly coat the catheter. Some physicians reject not only the fatty but all other lubricants, and think it sufficient to moisten the catheter with warm water. More soft catheters are destroyed by the excessive use of fatty substances than by any of the many other abuses to which they are subjected. Therefore there is need of a lubricant which shall not be irritating to the urethra, and which shall contain no fat and no free alkali to deteriorate the varnish of web catheters and soften rubber catheters. After examining different substances, it was thought that a watery solution of dry soap, with the introduction of some ingredient to add lubricity to its viscidity, would be likely to answer the purpose. On consultation with Dr. Charles Rice, the chemist of the Department of Public Charities in New York, the following formula for a saponic lubricant was agreed upon:

> White Castile soap, powdered, gr. cccIx;
> Tincture of quillaja (1 to 5), ʒss;
> Water, a sufficient quantity.
> (Product, about 1420 grains.)

To prepare, pour two fluidounces of water into a tared capsule, heat the water to boiling, and add the soap. Continue the heat, and stir until a homogeneous jelly is produced; then add enough hot water to make the contents of the capsule weigh two troy ounces and a half (twelve hundred grains), after which strain the mixture through cotton gauze. Lastly, pour in the quillaja tincture. This mixture, when cool, has the consistence of thick honey, possesses both viscidity and lubricity in a sufficient degree, and is free from any agent likely to be deleterious to the urethra or to the catheter. It may be preserved in an aseptic state in small collapsible tubes. The lubricant may be perfumed, or one per cent. of pure carbolic acid may be added. Among the experiments tried was an addition to the mixture of two drachms of chondrus crispus jelly (National Formulary). This slightly increased the lubricity, while it greatly increased the fluidity of the mixture. It is likely that the cetraria islandica will yield similar results.

7. All web catheters are liable to harden and to be unfit for use in the course of a few years, especially when they have not been in daily use. On the first appearance of the hardening process the instruments should be cast aside.

8. Rubber catheters harden and are brittle in about two years, or even sooner, if unused and exposed to the air. But when daily lubricated with fatty substances they seldom last more than three or four weeks, then swell, lengthen, and undergo a process of softening which renders them liable to be torn across during withdrawal, so that often several inches of this deteriorated rubber remain in the bladder.

9. After using a web catheter it should be well washed by forcing a stream of water through the instrument, which should then be dipped for a minute into a one-per-cent. carbolic-acid solution, thoroughly dried, wrapped in dry antiseptic gauze, and enclosed in a metal case. The drying process is begun by shaking off briskly the last drops of water from the interior of the catheter, which may then be ex-

posed to 120° F. of heat in a dry sterilizer or in any other way that may be safe and convenient.

10. Web catheters, even "ten-cent catheters," may be rendered aseptic also by boiling for ten or fifteen minutes, then drying thoroughly in a sterilizer, when they will be ready for use. During ebullition the catheters should not be coiled, but kept at full length and away from the bottom of the boiler. Dry sterilization may be accomplished as well just before using the catheter, but care should be taken to prevent the instrument from sticking to the metal.

11. Inasmuch as some time is necessarily consumed in the drying process, it is more convenient to a patient who is obliged to catheterize his bladder five or six times every twenty-four hours to be supplied with ten or twelve web catheters (No. 9 or 10 of the English scale), and to use two catheters each day, so that the same catheters may be used only once every five or six days. This plan has been pursued by a number of patients, who have all fully appreciated its advantages. In one of these cases, the patient relieving himself eight times daily, the catheters so used were carefully examined seven months after and found unaltered and in the best condition, each instrument having been used about one hundred and forty times.

American web bougies are made of the same materials as the catheters. They are, therefore, of the same grades,—cheap commercial cotton, flax, and ramie. A cotton olivary bougie Gouley prefers for general use. It is solid, slender in the first three inches of its shaft, and consists of a number of layers braided one upon another and coated with the same varnishes as the catheters, but it is distinguished from other bougies by its vermilion color. It has no ivory tip, is completely coated, and therefore easily rendered aseptic. The care of wrapping in gauze and enclosing in a metal tube is needed to preserve the instrument, which should be cast aside if it becomes fissured. It should be slightly warmed before introduction. No fats should be used as lubricants.

Whalebone bougies were used in France early in this century, and also in the United States. Dr. H. G. Jameson (*Medical Recorder*, 1827) spoke well of the utility of whalebone bougies of "the size of a small knitting-needle" in the treatment of urethral strictures. Whalebone bougies are of two kinds: those with olivary point and elbowed, about one millimetre in diameter, to serve as conductors for larger instruments, and those for dilatation of narrow strictures. The second, also elbowed and olive-pointed, are not over one millimetre in diameter for the first three inches, thence increasing gradually in diameter, so that at five inches they are equal to Nos. 2, 3, 4, 5, 6, and 7 English scale, the set comprising six bougies, as indicated by these numbers. All whalebone bougies require to be thinly coated with carbolized vaseline and preserved in metal tubes, otherwise they become dry and brittle and are soon destroyed by parasites.

ONE OF THE BEST APPLICATIONS OF IODOFORM IN SURGERY.

According to LANE (*Lancet*, July 15, 1893), in erasing tuberculous joints where the bone entering into their formation contained cavities, often of very considerable size, he has used iodoform very largely, not so much with a view of inhibiting the growth of organisms in the synovial cavity, but as a firm packing to occupy the cavity in the bone, which would otherwise be filled with blood, and would form a very formidable nidus for the growth of tubercle-bacilli. In such a joint as the knee or ankle, where every particle of synovial membrane can be thoroughly and effectually removed, there is not the slightest chance of recurrence, for the reason that the retention of a drainage-tube for forty-eight hours with firm pressure insures the accurate apposition of living tissues, all blood and other effusions having been driven out through the tube by the pressure of a flannel bandage, firmly applied. Where, however, a large cavity has been left in a bone, no amount of external pressure can influence it, and it must of necessity remain filled with blood and be a source of danger to the individual. Such a cavity he treats in the following way, and up to the present has never known it to fail: An Esmarch's bandage being applied above the joint to control the circulation, the joint is erased, and any cavity in the bone is thoroughly cleared out and the hole carefully dried with sponges. Some iodoform is then washed with 1 to 20 carbolic lotion, and poured on to a piece of lint and squeezed as dry as possible. It is then introduced in masses into the cavity in the bone and stamped firmly in, much as a dentist fixes a gold stopping in a carious tooth, and when the cavity has been completely filled, the surface of iodoform is planed down level with the surrounding bone. The following examples of the treatment are given:

CASE I.—This was a knee-joint in which there was a large collection of tuberculous material between the front of the lower end of the femur and the synovial membrane of the joint above the limits of which it extended. It projected forward so much that the joint presented the appearance of a typical tuberculous synovitis, for which it was naturally mistaken. Finding the synovial cavity healthy, the incision into it was closed and an opening inside made without the limit of the synovial membrane. The whole of the tuberculous material was cleared out from the shaft. A small aperture was found in the front of the bone in the position of the growing line. On enlarging this it was seen that it led into a carious cavity, which comprised almost every bit of both condyles of the femur, but in no place had there been extension through the articular cartilage, though in parts it alone formed the circumference of the cavity. This cavity was cleared out most thoroughly in the manner described, and was plugged with what seemed a very large quantity of washed iodoform. It is now a couple of years since the operation, and the girl possesses a movable joint, which, with the exception of the scar left by the incision, appears as normal and performs its functions quite as well as its fellow. It would be interesting to know how much of the iodoform has been removed and replaced by bone, and how much, if any, still constitutes a portion of her osseous skeleton. At the time of operation an extensive tuberculous periostitis in the pterygoid fossa and its vicinity was cleared out as effectually as possible, and the abscess cavity was filled with glycerin and iodoform. This, though improved by the operation, continued to discharge till quite recently.

CASE II.—This was a case of tuberculous disease of the ankle-joint. The subastragaloid-joint was free from disease, but the whole of the cartilage was destroyed on the opposing surfaces of the tibia and astragalus. The astragalus was so much destroyed that after removing the carious and softened bone little was left but a cavity whose wall was formed in great part directly by the articular cartilage covering the head, under surface, and malleolar facets, and in part by the same tissue covered by a thin layer of bone. Elsewhere the remainder of the cavity was formed by a thin shell of bone. When this cavity was packed with iodoform it was obvious that but a very small proportion of the astragalus consisted of bone, since it was practically an idoform and not an osseous astragalus. The lower end of the tibia was deeply excavated in parts, and these spaces were plugged in a similar way. The patient made an uninterrupted recovery, and is now at a convalescent home.

It will be noted that the above method of administering iodoform differs altogether from its employment as an emulsion. Lane uses the iodoform as a packing to occupy for a sufficient length of time—with a solid material which contains no organisms, and in which organisms cannot grow—a cavity which would otherwise contain blood in which micro-organisms might readily grow, especially if they were present in other parts of the body, this packing being gradually removed and replaced by bone.

GASTRO-ENTEROSTOMY; BEING A MODIFICATION OF SENN'S METHOD.

PAUL (*Lancet*, July 15, 1893) states that Senn's bone-plate method of performing the operation of gastro-enterostomy has been practised in the neighborhood of Liverpool about six times; and three patients are known to have lived long enough after the operation to test its results. Mr. Stansfield's patient lived for four months, symptoms of pyloric obstruction recurring about eight weeks after the operation. A post-mortem examination was made, and the new opening was found to be perfectly closed, with the silk ligatures *in situ*. Mr. Larkin's case, so far as the opening is concerned, proved to be an exact counterpart of Mr. Stansfield's; and there was Paul's case, in which the patient died about two months after the operation, with the opening contracted to at least one-third of its original size. These being the only "successful" cases in that district, it is perhaps not to be wondered at that physicians are a little shy of encouraging the operation of gastro-enterostomy for pyloric cancer.

The published records from other districts appear in some instances to be of a more hopeful nature; but prolonged relief is certainly the exception and not the rule, while the symptoms have in several cases pointed to a repetition of the Liverpool experience, though the result has not often been verified by post-mortem examination. In Senn's record of his original experiments there are only four examples of gastro-enterostomy. Of these, one dog died from causes indirectly connected with the operation on the following day, and another was killed on the seventh day; hence the first two have little or no bearing upon the question of the permanency of the opening. The third was killed on the thirty-fourth day, and the fistulous opening was found to be large enough

to admit the index-finger. The fourth was killed on the fourteenth day, and the opening was entirely closed. Mr. Bowreman Jessett records two experiments in which he repeated Senn's operation, killing one dog three weeks and the other a month afterwards, with the result that water passed freely through the opening in each case, but the size of the opening is not stated. Senn's explanation of the cause of closure is that either the opening in the bone-plates was too small or the lateral sutures had been passed too near the edge of the cut, thus allowing its margins to approximate. But whether this simple explanation is correct or not, and it is at least doubtful, the fact remains that both in the original experiments and in the practice of several surgeons subsequently the opening has closed. At the same time it may be said to have been clearly shown that a fistulous communication between the stomach and bowel may be established, even in very debilitated subjects, without great risk to life, and this is an important point. Having once learnt the secret of a safe operation, it is surely only a matter of detail to secure an opening which will prove to be more permanent.

Cases in the human subject seem to show that the inosculation is at first quite satisfactory, that for some six or eight weeks it remains fairly free, and that then it slowly contracts, with the recurrence of symptoms of obstruction. This points to the character of the opening being in fault rather than the bone-plates or the suturing. It is a clean incision, involving no loss of tissue, and clean incisions in the stomach tend to heal remarkably well. Probably the more food that passes through the new opening the better it is maintained, and in cases of combined pylorectomy and gastro-enterostomy, like Mr. Rawdon's and Mr. Jessett's, it would always be permanent; but the obstruction offered by a pyloric cancer is diminished by the temporary relief which the operation affords, just as rectal stricture yields for a time after colotomy. No doubt at first food again passes by the pylorus, as we know that fæces pass again by the rectum when no "spur" has been made, and in either case the new opening is liable to shrink. It was in the belief that the cause of failure is to be found in the character of the opening that some further experiments, presently to be described, were undertaken. Another drawback to the present method of operating is the necessity of bringing the jejunum across the transverse colon to attach it to the front of the stomach. In Paul's case this produced a condition of partial obstruction, which was very troublesome to the patient, owing to the constant distention of the cæcum with gas. The difficulty has been met in two ways, neither of which is at all satisfactory. One is to tear through the transverse meso-colon and gastro-colic omentum and to bring the jejunum through this opening to the front of the stomach; the other is to turn the whole stomach up and attach the intestine to the back instead of the front surface of it. The former plan has resulted in obstruction of the bowels through kinking, and the latter is a very difficult and sometimes impossible operation to perform in the presence of malignant disease.

The operation about to be described strangulates the connected surfaces of the stomach and intestine, effecting by sloughing a clean circular opening between the bowel and the back of the stomach, which, in experiments on dogs, has shown no tendency to diminish up to a period of one hundred and seven days, the longest experiment made. The special apparatus required involves nothing more than a hard ring, preferably of bone, about three-quarters of an inch in diameter for the human intestine, and perforated with four small equidistant holes. The ring may be rounded on all sides or only on one. This surface should always be round in order that it may not cut the piece out too sharply and lessen the breadth of surrounding adhesions. The four holes are charged each with a needle carrying a strong double silk thread, very securely double-knotted on the under side. For dogs, rings of half an inch in diameter were used, and the ligatures were generally tied over a second ring, though this was subsequently found to be unnecessary.

The operation is performed as follows: The abdomen is opened and the first part of the jejunum is found and brought out of the wound in the usual way. A small incision is made into the bowel, where it can be applied to the lower and back part of the stomach without the least tension. Through this small wound the bone ring is slipped into the bowel, the needles are passed, and the opening is temporarily closed. Next a cut of about an inch and a quarter in length is made in the front wall of the stomach opposite to the spot where the inosculation is desired, and the four needles are passed in regular order through the transverse meso-colon and posterior wall of the stomach and are brought out of the front opening. When they are drawn tight of course the intestine is firmly applied to the back of the stomach, and by cutting off the needles and

tying the ligatures tightly, the included disks of bowel and stomach are strangulated between the ring in the former and the ligatures in the latter. While the parts are still held forward by the ligatures, the centre of this area may be cut out with a tenotomy-knife, thus at once effecting a communication between the two viscera. Then the ligatures are cut short, the parts are allowed to drop back into position, and the opening in the front wall of the stomach is closed by a double row of fine green catgut sutures, by a continuous row in the mucous membrane, and by Lembert sutures in the outer coats. Finally, the stomach is turned up if possible, and a few Lembert sutures are applied on the outskirts of the inosculation to retain the parts in position when they lose the support of the ligatures by sloughing on the second day. These sutures are much more important in this than in Senn's operation; but if they cannot be used, owing to fixation of the organ by cancerous infiltration,—and it must be a very bad case in which none can be passed,—the patient must be kept very still for at least a week. Such additional support is less urgently needed when the intestine is applied to the back than when it is applied to the front of the stomach, as the tension in the former case is much less; but it should never be neglected. The abdominal wound is always closed with deep sutures of fishing gut, including all the tissues from the peritoneum to the skin.

The experiments were all performed upon mongrel terriers about the size of an ordinary fox terrier, and the part of the bowel used was the coil which happened at the time to be lying nearest to the lower and posterior part of the middle of the stomach.

In the first experiment two rings were used,—one in the intestine and the other in the stomach. No Lembert sutures were applied round the inosculation. The animal suffered very little from the operation, taking its food well all the time. It was kept on bread and milk for about a week, and then on ordinary diet. The bone rings, slightly digested, were passed on the fourth day in the second motion after the operation. The animal was killed on the thirty-first day, when the opening was found to be circular and free, but its size was not estimated until after the parts had been hardened in strong spirit, when it measured only one-third of an inch in diameter. The incision in the front of the stomach could hardly be detected, and there were scarcely any adhesions except those concerned in the gastro-enterostomy itself.

In the second experiment the proceedings were reversed, the first ring being inserted into the stomach and the ligature tied over a second ring in the duodenum through an opening on its opposite side. There was some tension on the bowel, but no supporting Lembert sutures were put in. The dog did very well for twenty-four hours, but then seemed to be rather uneasy, and on the following morning was found to be dead. An examination showed that the heavy duodenum—it is very thick in the dog—had partly broken through the fresh adhesions round the slough and had permitted a fatal extravasation. Until this case occurred the outer edge of the ring on the side next the viscera had not been rounded off nor had the surrounding Lembert sutures been used. Afterwards both modifications were adopted, but the operation was not repeated on the front of the stomach, as everything was more favorable for the opposite position.

In the third experiment the operation was performed as in the first case, but with the precautions suggested by the second. The dog did well throughout, and was not killed until the one hundred and seventh day. He had increased in weight. The opening was found to have been made between the back part of the stomach near the pylorus and the commencement of the colon. It readily admitted a half-inch test-tube, thus showing that in this long period it had undergone no contraction. This case is particularly valuable, because it is almost certain that the opening must have been quite functionless, and still did not contract. Had food passed through it into the colon nutrition would have suffered, and had fæces escaped by it into the stomach, vomiting, as was shown by a subsequent case, would have occurred.

In experiment four the steps of the operation were the same as those of the last experiment. The animal was stronger than any of the others at first: it passed the rings on the fourth day. After about a week it suddenly began to throw up yellow vomit, and later fæcal vomiting became so severe that it was thought advisable to have the dog killed on the twenty-second day. On examination, a full-sized opening was found (five-eighths-of-an-inch rings were used) between the back of the middle of the stomach and the small intestine, rather less than half-way down. The mucous membrane of the stomach was a good deal congested. Evidently fæcal matter had poured freely through the new opening into the stomach, while food had apparently left chiefly by the pyloric orifice. It is unnecessary to point out that this

course of events could not occur when the upper part of the intestine was selected or when the pylorus was strictured.

In the fifth experiment the operation was similar to the last experiment, but only one ring was used, the ligatures being tied in the stomach on the bare mucous membrane. The ring was carefully looked for, but could not be found, so it was probably digested. The animal made an excellent recovery, except for a short attack of fæcal vomiting, but accidentally swallowed some poison in the toxicological laboratory, and had to be killed on the twenty-fourth day. At the post-mortem examination the same clean circular opening was found, measuring a full half-inch in diameter, and at about the same position of the parts as in the last case.

The following conclusions are justified by the experiments just related: (1) that the operation of gastro-enterostomy, when performed in this way with due precautions, is not more dangerous to life than with the decalcified bone-plates; (2) that the new opening is in a better position; (3) that it will not spontaneously close; and (4) that it involves no unnatural displacement of the bowel in bringing it into contact with the stomach. It is not claimed for this proceeding that it is anything more than a modification of Senn's operation, and the idea of working through an accessory opening was obtained from Dr. Maunsell's paper on "Resection of the Intestine," published in the Transactions of the Intercolonial Medical Congress of Australia for 1889.

Should experience in the human subject show this to be a more dangerous proceeding than Senn's, it might still be utilized as a method of attaching the intestine to the back of the stomach by means of his decalcified bone-plates,—a difficult and often impossible process to accomplish with safety by his method of operating. It having been suggested that the results would have been more reliable had the pylorus been obstructed at the same time, a further experiment has since been undertaken (May 17). In this the duodenum was first almost entirely occluded by excising a crescentic portion, and then the intestine just below was attached to the back of the pyloric end of the stomach. At first the dog suffered severely from this double operation, but after about ten days it began to improve, and is now doing well and is increasing in weight, though all food has certainly to pass by the new opening. In July this animal, unfortunately, was lost, it being at the time in excellent health.

THE TREATMENT OF SYPHILIS BY MEANS OF HYPODERMIC INJECTIONS.

EUDLITZ (*Monatshefte für Praktische Dermatologie*, Bd. xvii., No. 2), basing his observations on a particularly rich experience, announces the following facts in regard to the use of hypodermic injections of mercury in syphilis:

1. Subcutaneous injections of salts of mercury afford an excellent means of treating syphilis.

2. This treatment is not applicable to patients suffering from disease of the kidney, or to those who are cachectic.

3. The advantages of the hypodermic treatment lie in the exact dosage and the rapid therapeutic effect; its disadvantages, in the pain and local reaction. These latter are, however, avoidable to a great extent.

4. Insoluble preparations insure the chronic mercurialization of the system. In the most severe cases calomel and yellow oxide are advisable; in lighter cases the thymol acetate of mercury.

5. When the patient is not in good general condition, and when the mucous membrane of the mouth is not healthy, insoluble preparations should not be used.

6. The soluble preparations of choice are sublimate, peptonate of mercury, and biniodide.

7. Sozoiodolate of mercury is a very powerful preparation, but causes considerable pain, on which account its application is limited.

EVANESCENT URTICARIA CURED BY THE CONSTANT CURRENT.

SCANGA (*Riforma Medica*, 1893, No. 72) observed a case of urticaria in a nervous student, characterized by unusually violent pruritus. The wheals appeared rapidly and disappeared as quickly. The skin was extraordinarily hyperæsthetic, and showed to an unusual degree the phenomena of dermographismus.

The writer believes that there was here an irritable condition of the vaso-motor nerves. The patient was treated by means of the galvanic current and the internal administration of strychnine. Cure was prompt and complete.—*Monatshefte für Praktische Dermatologie*, Bd. xvii., No. 2.

TREATMENT OF EPITHELIOMA.

DARIER (*Bulletin Général de Thérapeutique*, 62 année, tome cxxii.) treats superficial epitheliomata by first removing surface crusts and sloughs by antiseptic poulticing, then painting

the diseased surface with a concentrated solution of methyl blue (ten per cent.) in glycerin and alcohol, touching all the dyed surface with a steel point which has been dipped in a twenty-per-cent. solution of chromic acid, finally reapplying the methyl blue and dressing with compresses wet in weak antiseptic solutions. The treatment is repeated at intervals of two days for weeks or months. In severe forms of the disease interstitial injections of methyl blue are indicated.

The methyl blue is employed mainly to stain the lesions, so that they can be reached by the caustic. The method is particularly indicated in cases of epithelioma of the eyelid. Six successful cases are cited.

THE VALUE OF CRANIECTOMY AND THE EDUCATION OF THE IDIOT YOUNG.

The *Lancet* (No. 3646) in an editorial article treats of this subject as follows:

French Canada enjoys an honorable record in the care and cure of the idiot young. Half a century ago Seguin achieved results quite astonishing in the rescue of these unhappy "victims to society's misdeeds." His methods were those of the educator rather than those of the physician, but he broke ground on which medical advance was shown to be possible, inasmuch as he may truly be called the pioneer of that combined system of training, mental and physical, which has been pursued with such gratifying success at Earlswood, in Dublin, and in Dundee. Just sixteen years ago a new and a bolder method was introduced, again from French Canada. Dr. Fuller, of Montreal, advocated craniectomy for the relief of the idiot young, and in 1877 performed the first operation ever attempted with that object. He made an incision in the cranium of an idiot, with the avowed aim of giving expansion to the cerebrum and of obviating the mischief arising from "la suture prématurée." The method was followed up, in France particularly; and on May 9, 1890, Dr. Lannelongue, Professor of Surgical Pathology in the University of Paris, repeated Dr. Fuller's operation on an idiot girl of four years of age, and reported the case to the Académie des Sciences. His success appeared sufficiently encouraging to warrant other operators as well as himself in practising Dr. Fuller's method, and his first report was followed by two memoirs, in which he passed in review the results of twenty-five cases that had come under his own treatment. Of these he claimed twenty-four as "cures," and stated that the mean interval between the operation and its successful issue was ten days.

Dr. Bourneville, one of the clinical staff of the Bicêtre Hospital in Paris, at a recent meeting of the Académie de Médecine, read a paper on the entire subject, which he thought had been long enough under medical cognizance to justify a review of its present position. What have been the ascertained results of surgical intervention in cases of infantile idiocy? From the intellectual, moral, and physical point of view what benefits can we really trace to it? His answer, though not absolutely discouraging, does not seem to coincide with Dr. Lannelongue's somewhat sanguine conclusions. He admits, amidst the scanty information that has come from abroad supplementing Dr. Lannelongue's experience, that a certain amelioration has in some cases been effected; but further than this he declines to commit himself, and desires more statistics scientifically checked. Nay, he has not been able to corroborate the improvement witnessed in the favorable cases, which he surmises may be due to the exceptional care which has been bestowed on these little patients.

Dr. Bourneville brought to the notice of the academy a collection of crania from the pathological museum of the Bicêtre Hospital, which seem to indicate very pointedly that in the case of idiots and arrested organisms of the same kind there is, generally speaking, no premature junction of the sutures. Moreover, by a series of photographs of the cerebra contained in these crania, he demonstrated the existence of deep-seated lesions in the former, lesions of which the gravity awakened doubts as to the curative value claimed for craniectomy in the majority of Dr. Lannelongue's cases. Far too profound, far too extensive as well as intensive, far too diversified, in his opinion, are those lesions to have proceeded from osseous obstruction, or to be removed or even modified by Dr. Fuller's operation.

Not only so, but, according to Dr. Bourneville, craniectomy has too often been productive of grave "accidents" of actual injuries, such as paralysis and convulsions, sometimes even of death itself. In these circumstances, so far from his counsel being (with Dr. Lannelongue) an abandonment of the medico-pedagogic method initiated by Seguin, he recommends a return to it,—a return to it, that is to say, under the more perfect conditions elaborated by skilled practitioners. Such a system, judiciously applied and perseveringly prolonged in suitable cases,

may be expected to result in successes even more signal than those already achieved. At the same time, Dr. Bourneville would hardly induce us to put a veto on surgical intervention in infantile idiocy. Such intervention, practised in cerebral lesions of apparently an even less hopeful character, has often enough realized expectations to warrant not only its repetition, but its extension to all cases in which osseous obstruction of the cerebrum has been fairly diagnosed. The truth, indeed, seems to lie between the methods of both schools,—the surgical and the medico-educational. In Italy, as we pointed out a year ago, Dr. Fuller's operation has been performed with such success as to have passed into the recognized resources of surgery. We have yet to obtain a series of statistics "scientifically checked" which shall give us the results of a combination of the two systems,—that of surgical intervention followed up, or rather accompanied, by that of the pedagogic authority.

Reviews.

REACTIONS: A SELECTION OF ORGANIC CHEMICAL PREPARATIONS IMPORTANT TO PHARMACY IN REGARD TO THEIR BEHAVIOR TO COMMONLY-USED REAGENTS. By F. A. Flückiger, Ph.D., M.D. Translated, revised, and enlarged by J. B. Nagelvoort. Authorized English edition.
Detroit: George S. Davis, 1893.

This is certainly one of the most useful of books for both the physician and pharmacist. It does itself an injustice in having the somewhat concise title of "Reactions," for while it is devoted to a careful description of the reactions characteristic of various substances, both those derived from the mineral and vegetable kingdoms, it contains an amount of information far in excess of that which one would imagine from such a title. It is published on handsome glazed paper with wide margins, and is one of the most neatly printed books of its kind that we have ever seen.

In view of the large amount of money which is to be obtained by the preparation of various medicinal substances, many manufacturers, intentionally or otherwise, may place upon the market samples which are not as pure as they might be. With this book at hand, the physician and pharmacist can readily detect sophistication or lack of purity.

We note that through the entire book the final *e* is dropped in the case of alkaloids, and as a result no distinction in the spelling is made between glucosides and alkaloids. We are well aware that there are good reasons for dropping the final *e*, but we believe that there are still better reasons for retaining it.

Mr. Nagelvoort is to be congratulated upon his careful translation of a somewhat difficult text, and upon the additions he has made to Professor Flückiger's well-known work. Both the translation and the additions are acknowledged in a pleasant note from the author, a *fac-simile* of which is printed opposite the author's picture on the first page.

A MANUAL FOR BOARDS OF HEALTH AND HEALTH OFFICERS. By L. Balch, M.D., Ph.D.
Albany, N. Y.: Banks & Bros., 1893.

This small manual, numbering some two hundred and fifty pages, will doubtless prove of much value to medical men who are connected officially with boards of health in city or State. It details the powers and duties of a State Board of Health, the question as to the removal of patients, and the suppression of epidemics. It also contains blanks to illustrate the best forms to be employed for the notification of nuisances and other functions connected with the duties of a health officer, while the last hundred pages consist in the reprinting of the laws of the State of New York in relation to the public health.

MEDICACION Y MEDICAMENTOS CARDIO-MOTORES. Por D. Antonio Espina y Capo. Segunda edicion, corregida y considerablemente aumentada.
Madrid: Administracion de la Revista de Medicina y Cirugia Practicas, 1893.

This small octavo volume of three hundred and thirty pages consists of a description of the botanical source, physiological action, and therapeutic value of practically all the drugs which are used as cardiac stimulants, even including sulphate of quinine and ergot. While we have not been able to discover that the author has added anything to the literature of the subject in the sense of original observation, it forms an interesting and complete, though brief, summary of the subject of which it treats, and so good a one that we should not be surprised if a translation were published in this country. The present work is an enlarged second edition.

LEÇONS DE THÉRAPEUTIQUE. Par Georges Hayem.
Paris: G. Masson, 1893.

This volume by the well-known Professor of Therapeutics in the Faculty of Medicine in Paris consists of his fourth series of lectures

upon therapeutic topics, and discusses the medication of dyspepsia, dyspnœa, cough, expectoration, albuminuria, uræmia, and excessive sweating. In conjunction with the three earlier volumes, this one completes the work which has been appearing during the last few years.

The book shows that the author is fully in touch with the recent advances which have been made in the study of functional diseases of the stomach, and copious accounts are given of the various tests for hyper- and hypo-acidity which modern study of gastric affections has proved to be so important for correct diagnosis and treatment.

This is the most complete work upon the subject of the treatment of the common and distressing symptoms of functional disease that has been published. The lectures upon the treatment of dyspepsia take up the greater part of the book, the other subjects being discussed with comparative brevity. A carefully-prepared index, much more complete than that which usually is published in French works of this character, closes the volume.

THE PHARMACOPŒIA OF THE UNITED STATES OF AMERICA. Seventh decennial revision (1890). By authority of the National Convention for Revising the Pharmacopœia, held at Washington, A.D. 1890. Official from January 1, 1894. Published by the Committee of Revision.

Printers and binders: J. B. Lippincott Company.
Agents: P. Blakiston, Son & Co., Philadelphia.

We feel confident that the medical profession will be much pleased with the manner in which the Committee of Revision has performed its difficult task. Much good judgment is required in the revision of our standards, and it is a matter for congratulation that the committee has been conservative rather than overanxious to make many changes. In changing the names or strength of preparations, the foremost thought has been the safety of so doing.

Among the subjects considered was the proposition to drop the final *e* in the spelling of oxide, bromide, chloride, iodide, bromine, chlorine, iodine, etc., and also in alkaloids; thus, oxid, chlorid, bromid, iodid, morphin, strychnin, etc.

We agree with the committee that such a radical change is not at this time justifiable. The terminal *e* in alkaloids serves to distinguish them from neutral principles.

A change which *was* considered advisable was to place the name of the basic element first in the title of chemical compounds, such as salts, oxides, hydrates, etc.; thus, instead of chlorate of potassium, sulphate of magnesium, benzoate of sodium, etc., we have potassium chlorate, magnesium sulphate, sodium benzoate, etc. In naming the chemical compounds of mercury and iron still further changes were made in using the terms *ous* and *ic* to indicate whether they are the higher or lower compounds of these metals; thus, ferrous sulphate, ferric sulphate. The distinguishing adjectives were retained in the mercury compounds; thus, *mild* mercur*ous* chloride, *corrosive* mercur*ic* chloride, *yellow* mercur*ous* iodide, *red* mercur*ic* iodide, etc., these changes harmonizing the chemical and the pharmacopœial names of such compounds. The names of some other substances have undergone change also. Chloroform signifies the purified product, ether is purified ether; the commercial preparations of ether and chloroform have been discarded. Aloes becomes socotrine aloes, creasote now creosote, brayera becomes kousso. The mixtures of asafetida, almonds, ammoniac, and chloroform are designated emulsions; mixture of iron and ammonium acetate now is properly solution of iron and ammonium acetate. Green soap becomes soft soap, and tincture of green soap, liniment of soft soap. Denarcotized opium becomes deodorized opium, and deodorized tincture of opium, tincture of deodorized opium. The name of *green* iodide of mercury has been changed to *yellow* mercurous iodide. We are in perfect accord with the committee in the careful revision of the names of these preparations.

After carefully considering the advisability of establishing a fixed proportion of active principles in preparations made from the more energetic drugs capable of being assayed, it was decided at this time to apply the process of assay only to cinchona, opium, and most of its preparations, and to the preparations of nux vomica. This is a step in the right direction, and we are promised that the list of assayed preparations shall be increased upon the next revision.

Comparatively few changes have been made in the strength of the various preparations. The following are some of the most noticeable: Phosphoric acid now contains 85 per cent. absolute acid instead of 50 per cent.; sulphurous acid, 6.4 per cent. absolute acid instead of 3.4 per cent.; chlorinated lime should contain 35 per cent. available chlorine instead of 25 per cent.

The general formulæ for decoctions and infusions is about 1 part of the substance to 5 of water, instead of 1 to 10. The strength of

tincture of stramonium-seed and tincture of physostigma is about one-half that of the Pharmacopœia of 1880. One grain of saccharated pepsin should digest three hundred grains of freshly-coagulated pepsin instead of fifty grains.

Ninety articles have been dismissed and eighty-eight new ones added to our official list. Among the most important additions are acetanilid, salol, resorcin, naphtol, naphtalin, eucalyptol, menthol, thymol, terebene, terpin hydrate, pepsin, pancreatin, hydrous wool fat, cocaine hydrochlorate, hydrastine hydrochlorate, hyoscine hydrobromate, hyoscyamine hydrobromate, physostigmine sulphate, sparteine sulphate, caffeine citrate, chloroform water, hydrogen dioxide water, absolute and deodorized alcohol, elixir of phosphorus, aromatic elixir, glycerites of boroglycerin, hydrastis, carbolic and tannic acids, fluid extract of *Rhamnus Purshiana* (cascara sagrada), tincture of strophanthus, vegetable cathartic pills, pills of carbonate of iron (Blaud's pills), spirit of glonoin (nitro-glycerin), spirit of phosphorus, aloin. The addition of these substances are justified by their frequent use, but we should have been pleased to have seen the following added also: Camphoric acid, ammonium ichthyo-sulphate, ethyl bromide, methyl chloride, apiol, cactus grandiflorus, pelleterine, or some agreeable preparation of this alkaloid, copper arsenite, and a liquid preparation to correspond to distilled extract of hamamelis.

We are sorry to see dismissed from the Pharmacopœia the mixture of potassium citrate, an old and much-used preparation. The dismissal of the whole class of abstracts is due to the fact that they have never become popular. This is to be regretted, as they are the only class of solid preparations bearing a definite relation to the strength of the crude drug from which made. It will be remembered that each grain of the abstract represented the strength of two grains of the crude drug mixed with sugar of milk.

The weights and measures are given exclusively in the metric system. This change has been made so gradually that no one should complain of not being familiar with this system of weights and measures. The Pharmacopœia having been adopted as a standard authority by our government and many of the States, the word "official" replaces "officinal." Complete tables of all the articles added and dismissed, change of names in the English and Latin, and tables comparing the strength of the preparations of the more energetic drugs with those of the Pharmacopœia of 1880 add decidedly to the value of the work. The type is clear, the paper good, and the binding is neat and durable. The book becomes official January 1, 1894. E. Q. T.

Notes and Queries.

THE WILLIAM F. JENKS MEMORIAL PRIZE.

The third triennial prize, of five hundred dollars, under the deed of trust of Mrs. William F. Jenks, will be awarded to the author of the best essay on "Infant Mortality during Labor, and its Prevention."

The conditions annexed by the founder of this prize are, that the "prize or award must always be for some subject connected with obstetrics, or the diseases of women, or the diseases of children;" and that "the trustees, under this deed for the time being, can, in their discretion, publish the successful essay, or any paper written upon any subject for which they may offer a reward, provided the income in their hands may, in their judgment, be sufficient for that purpose, and the essay or paper be considered by them worthy of publication. If published, the distribution of said essay shall be entirely under the control of said trustees. In case they do not publish the said essay or paper, it shall be the property of the College of Physicians of Philadelphia."

The prize is open for competition to the whole world, but the essay must be the production of a single person.

The essay, which must be written in the English language, or if in a foreign language, accompanied by an English translation, should be sent to the College of Physicians of Philadelphia, Pa., U. S. A., before January 1, 1895, addressed to Horace Y. Evans, M.D., chairman of the William F. Jenks Prize Committee.

Each essay must be type-written, distinguished by a motto, and accompanied by a sealed envelope bearing the same motto and containing the name and address of the writer. No envelope will be opened except that which accompanies the successful essay.

The committee will return the unsuccessful essays if reclaimed by their respective writers, or their agents, within one year.

The committee reserves the right not to make an award if no essay submitted is considered worthy of the prize.

JAMES V. INGHAM,
Secretary of the Trustees.

August 1, 1893.